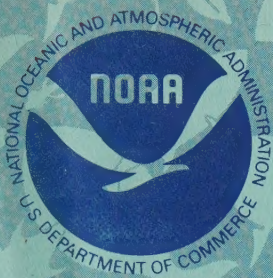


LJ-80-07



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MAY 1980

A TIME SERIES OF AGE COMPOSITION AND
APPARENT ABUNDANCE OF THE NORTHERN ANCHOVY,
ENGRAULIS MORDAX, WITH INFERENCES ABOUT
THE STRENGTH OF RECRUITMENT

BY

PAUL E. SMITH AND CYNTHIA A. HAIGHT

ADMINISTRATIVE REPORT LJ-80-07

Abstract

Age structure of the virtual population of the northern anchovy central subpopulation is assembled from the commercial catches for bait and reduction and from the sea survey and compared. The time series from the beginning of the reduction fishery (1966) and the most recent sea survey methods (1969) using sonar and trawl are comparable and major recruitment events are registered by both methods. The year-classes from 1964 to present are represented closely by sonar-trawl sea surveys over a wide area and from the commercial fishery over a small area.

A Time Series of Age Composition and Apparent Abundance
of the Northern Anchovy, Engraulis mordax, with
Inferences about the strength of recruitment

Paul E. Smith and Cynthia A. Haight

Pelagic schooling fishes cannot yet be adequately censused. Various attempts to do so fail owing to 1) the heavy logistical demands of observing and sampling fish over wide geographic areas, 2) the "patchy" distribution of schooling fishes in school groups, and 3) the movement of fish during a given survey and between adjacent surveys. In addition to the barriers to estimating abundance there are likely to be differences in the migration range and rates of swimming which are size-specific and therefore to a degree age-specific. There are several sampling problems associated with constructing a population model from observations of the commercial catch, observations of the catch from sea surveys of juveniles and adults, and spawning surveys of the eggs and larvae. It is one purpose of this report to explore the fusion of these sampling techniques for the central sub-population of the northern anchovy so that our perception of the population structure is improved.

Smith (1972) documents the surveys of eggs and larvae and the larval method of estimating biomass which is now used in the Anchovy Management Plan (Anon. 1977). The sea surveys of the California Department of Fish and Game have been the subject of annual data reports and Mais (1974, 1977) has summarized some findings as they relate to acoustic surveys of the anchovy and other commercial fish concentrations. There are also annual reports of the catch of the northern anchovy by age class.

From the spawning surveys it is known that the central subpopulation is far more widespread than either the fishery or the CF&G sea survey. The samples taken from the fishery mostly represent purse seine catches within 20 miles of San Pedro, an area of less than 1,000 square nautical miles. The catch of the sampling trawl on sea survey cruises is derived from a much larger area, 80 miles in the east-west dimension and usually about 500 miles in the north-south dimension or 40,000 square nautical miles. From egg and larva surveys over a 300,000 square nautical mile area over the past 30 years, it appears that the northern anchovy central subpopulation (Figure 1) occupies about 80,000 square nautical miles concentrated in the shoreward 40,000 square nautical miles occupied by the CF&G sea surveys.

It is unreasonable to expect that the fishery and the sea survey age composition would agree in detail and similarly we may expect some differences between either age composition and the population age composition. One might also expect the agreement or disagreement to vary from year to year. The purpose of this report is to compare the age composition of the commercial fishery and the sea survey. Also, it should be possible to compare some features of the age compositions with the changes in the spawning stock size. The ultimate purpose is to examine these methods of population study for construction of a population model and a fusion of methods for most effective monitoring of the important changes in population size age composition and distribution and verification of recruitment.

METHODS

The age structure of the commercial catch was taken from the published reports of the California Department of Fish and Game (see Sunada, 1977) and by personal communication of John Sunada for the most recent years.

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The age structure of the sea survey was assembled by a program (see appendix), which allocated the catch of each trawl during a cruise to the age composition of a sample (usually 10 fish) and the trawl values were summed for a cruise.

RESULTS

The longest index of abundance is that derived from scales deposited in varved sediments (Soutar and Isaacs, 1974) of an anoxic basin off the Santa Barbara, California (U.S.A.) coastline (Figure 2). This particular basin underlies an extremely small proportion of the spawning area of the northern anchovy so that the same biases characteristic of the commercial fishery landings at San Pedro are possible. There is such substantial agreement with the population trends exhibited by the current population size indices (Smith, 1972; Anon. 1978) the magnitude and timing of long-term population trends are accepted as useful (Gulland, 1971; Smith, 1978).

The current estimates of apparent abundance of the central subpopulation of the northern anchovy used for fishery management (Anon., 1978) are plotted in Figure 3. The major features of agreement are the decade-long sustained biomass increase and subsequent decrease to 1969. Since then the major population changes have been an increase through 1975 and a drastic decline to 1978. Recent development of a direct estimation of absolute abundance (Hunter and Goldberg, 1979; Parker, MS) supports the general estimates of population size estimated indirectly by Smith (1972) using larval surveys of sardines and anchovy. Unfortunately for the time series, the spawning behavior for the northern anchovy described by Hunter and Goldberg casts new doubt (MacGregor, 1968; MacCall, In Press) on the assumptions made by earlier authors (MacGregor, 1964; Murphy, 1966;

Ahlstrom, 1968; Smith, 1972). In particular, the use of the sardine biomass to establish the level of anchovy biomass is now questionable unless the sardine spawning frequency is similar to the anchovy. No satisfactory resolution of this problem will occur until *Sardinops* (pilchard) spawning biology is known in equal detail.

The number of new young fish which become available to the fishery each year ("recruitment") cannot be effectively predicted from knowledge of the biomass of the spawning portion of the population ("stock"), except at extremely small population sizes. For example, the large anchovy stocks of 1974 and 1975 yielded very few recruits leading to the massive decline of the central subpopulation in 1976 (Eppley, pers. comm.) which has been sustained at a low level through 1978 (Anon., 1978).

Two severe limitations of the egg and larval method for study of populations are 1) the estimate of spawning biomass obtained does not yield any information on the age structure of the spawners, and 2) the egg and larval abundances and estimates of mortality rates therefrom seldom yield information on the size of the year class to result from that spawning season. With regard to the first point on age composition, a stationary population experiences increases in spawning capacity through growth of the spawners in the previous years' stocks and through the recruitment of new spawners and equal decreases in spawning potential through death of adults. These important population events cannot be defined by spawning surveys to estimate biomass.

One method of assessing the information on the relative contribution of increased spawning capacity by a population is to monitor the virtual

population with aged catches from commercial and sea survey origins. The age composition of the catches for 1955-1956 and 1956-1957 are in Figure 4. However, the biases of each method should be appreciated to appropriately constrain the use of the virtual population age structure estimate. None of the biases to be described can now be verified owing to the insufficient sampling effort and analysis of existing samples.

One potential bias of the commercial sample from San Pedro is the small commercial fishing area relative to the subpopulation area indicated by spawning surveys (Kramer and Smith, 1971). Another potential bias is that most fishing effort is conducted on "fishable concentrations" (by definition) which are frequently located by a single fishing boat or airplane observer ("air spotter") and the fleet subsequently aggregates in a very small area for a long time. Information from acoustic surveys (Mais, 1974; Vent, Davies and Brown, 1977; Hewitt, Smith and Brown, 1978; Holliday, 1978; Hewitt and Smith, MS) is consistent with respect to one feature, a very small proportion of the fish schools and fish school groups can be considered "fishable concentrations" because most of the schools are physically too small, many larger schools are too thin in the vertical dimension or too horizontally dispersed to be fished effectively, and many and school groups detected contain fish which are illegal to land because fish are too small (<127 mm TL, <110 mm SL) for reduction purposes in California. "Pulse" fishing by the fleet on a small proportion of the fish in a small geographic area can lead to non-representative samples of the age structure of the total population. One unexplained example of non-representative data from catch sampling is that the female to male ratio is 1.6 to 1.0 (Klingbeil, 1978).

The sea surveys also have potentially important biases. The sea survey normally covers the inshore half of the central subpopulation distribution area. Spawning surveys indicate that the inshore half contains most of the spawn. There still exists a possibility that a wider ranging longer and older anchovy might not be sampled representatively, but the problem would appear much less important than the similar bias in the commercial fishery. Another unevaluated bias in the sea survey is the allocation of virtually all the trawling effort to schools and groups of schools detected by sonar and echo sounder during the daytime immediately preceeding the night of trawling. It is possible that the nearshore areas are undersampled relative to the more offshore sites owing to coastal upwelling altering the depth of the surface mixed layer and the consequent shortening of the effective sonar range of detection of schools. It is also possible that the anchovy concentrates in the nearshore areas, harbors and estuaries in a systematic way regarding age of fish and are therefore under-represented in the samples. Lastly, it is possible that a large proportion of the fish are in loose aggregations which are not detected by the Alaska sonar and are, therefore, under-represented by trawl sampling allocated by sonar. The sex ratio of sea survey catches of anchovy is 1.09 favoring the female as does the commercial catch but far less so (Klingbeil, 1978).

Figure 5 is the percentage age composition of sea surveys and commercial catch sampling from 1952 to 1978. The general differences are the incidence of juveniles in the sea survey and a 7-year-old fish sampled in the years

1967 and 1975, where neither of these categories appear in the commercial catch. There are also several differences apparent in the location and relative height of the modal age group. Disagreements appear much more severe in the years before the inception of a sizeable reduction fishery (1966) and before the standard trawl-based sea survey (1966) using acoustics. General features after the 1965-66 catches show reasonable agreement (Fig. 6).

In Table 1 are reported the originally reported age structure from both the sea survey and the sampled commercial catch. In adjacent columns, both sets have been modified to make them more comparable. The juveniles and fish older than 3 years have been removed from both groups and percent composition recalculated. The 4 represented year-classes comprise an average of 94% of the commercial catch and 92% of the sea survey catch. The catches have then been assembled into year classes (i.e., all fish with the same year of birth regardless of the year of capture). Table 2 contains the assembly of data for estimating virtual contribution of catch by year class.

The two sources of age structure modified as described above are then plotted relative to the usual contribution to catch by a year class. The terminal 3 year classes on either extreme of the time series have been normalized to 100% by division of the actual proportion of catch by the average proportion of catch of the similarly limited age grouping. Figure 5 exhibits good agreement for the years in which the sea survey and the reduction fishery were well sampled following 1966. In particular, the population collapse of 1974-75 and the relatively large year class of 1976 are clearly portrayed.

Recruitment levels can be inferred from the abundance time series and from the virtual contribution to catch. During the period of the small fishery and the night-light blanket-net surveys, it appears from the biomass time series that the large recruitment of 1959 did not take place or was restricted to the area of the fishery.

How frequently can the eventual virtual contribution to catch be predicted from the relative proportions of catch of the first year class to be recruited? Neither the sea survey nor the commercial catch sample shows a significant correlation between the fraction of a year-class contributing in the "0" group year and subsequent contributions to catch in the I-II-III years in the fishery. The catches of I-II-III year fish are weakly correlated among sea survey and commercial catches.

DISCUSSION

The conditions for use of catch-per-unit effort data for monitoring the size of the northern anchovy population do not appear to be satisfied in the fisheries and surveys of the central subpopulation at present. The fishery independent methods agree on the gross trends of population size. The management objective of the fishery is to allocate the total allowable catch among the users for maximum sustained benefit. The initial information is the spawning biomass in the winter and spring preceeding the fishery. A sizeable portion of the stock, at times the majority, will have been spawned 1.5 years before the season of regulation and a large portion of this "cohort" may not be estimated by the spawning biomass

survey owing to light weight and diminished proportion of maturity. At that time the spawn of the preceeding winter may grow to catchable size prior to the close of the season in which they are allocated. For this stock, then, most of the generation time of the organism, ca. 2.4 years, will not be taken into account when setting catch quotas.

The most conservative course of action is to allocate only those year classes demonstrated to be present by the spawning surveys and assume that no recruitment will take place. Another course of action is to calculate the average rate of recruitment and allocate that as well. It might also be wise to develop direct measures of recruitment strength and set the quota using the estimates of spawning biomass and estimates of the recruitment strength. In the time series published here, it appears that extremely low recruitment levels like those in 1974-75 and in 1965-66 will be forecast.

It is apparent that the catch of "0" group fish and 1-year-olds is far below their level of incidence. The sea survey catches more of the first 2 year classes than the commercial catch, but they are still far under-represented based on simple life-table estimates of their abundance and total life span. It is possible that the methods of the sea survey are amenable to conversion to more rigorous allocation of sampling effort, to include more sampling of fish in scattered schools or in the nearshore habitats, so that the under sampling is corrected and the sea survey sample set is representative of the population.

It is also possible that a wider array of samples from ports other than San Pedro and from the sport fishery for anchovy bait could be made representative of this population.

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Table 1a. Sea survey catch analysis.

Season	J	0	I	II	III	IV+	0	I	II	III	
1952		20	48	21	8	3	.21	.49	.22	.08	
3		44	35	17	2	1	.45	.36	.17	.02	
4	33	38	26	2	1		.57	.39	.03	.01	
5		34	31	31	3		.34	.31	.31	.03	
6		51	12	33	4		.51	.12	.33	.04	
7		80	19	1			.80	.19	.01	0	
8		18	74	4	4		.18	.74	.04	.04	
9		11	64	22	2	1	.11	.65	.22	.02	
1960		8	36	48	7		.08	.36	.48	.07	
1		27	42	19	9		.27	.42	.19	.09	
2		28	38	27	6		.28	.38	.27	.06	
3		10	23	31	27	9	.11	.25	.34	.30	
4		5	36	29	24	6	.05	.38	.31	.26	
5		17	24	33	23	4	.18	.25	.34	.24	
6	T	1	36	33	28	3	.01	.37	.34	.29	
7	T	16	14	16	39	15	.19	.16	.19	.46	
8		7	33	33	1	26	.09	.45	.45	.01	
9	4	36	32	21	5	3	.38	.34	.22	.05	
1970		22	22	35	18	3	.23	.23	.36	.19	
1		3	46	35	11	5	.03	.48	.37	.12	
2		4	44	36	13	3	.04	.45	.37	.13	
3		6	17	37	32	8	.07	.18	.40	.35	
4		6	13	35	35	11	.07	.15	.39	.39	
5	35	15	5	18	17	9	.27	.09	.33	.16	
6		78	7	4	8	3	.80	.07	.04	.08	
7		14	66	10	7	3	.14	.69	.10	.07	
1978*		62	16	20	T	T	(.63)	(.16)	(.20)	(T)	
							$\bar{x}$	.26	.34	.26	.13
							s	.23	.18	.13	.13
							n	27	27	27	27
							$\bar{x}$	.25	.34	.26	.14
							s	.22	.18	.13	.13
							n	26	26	26	26

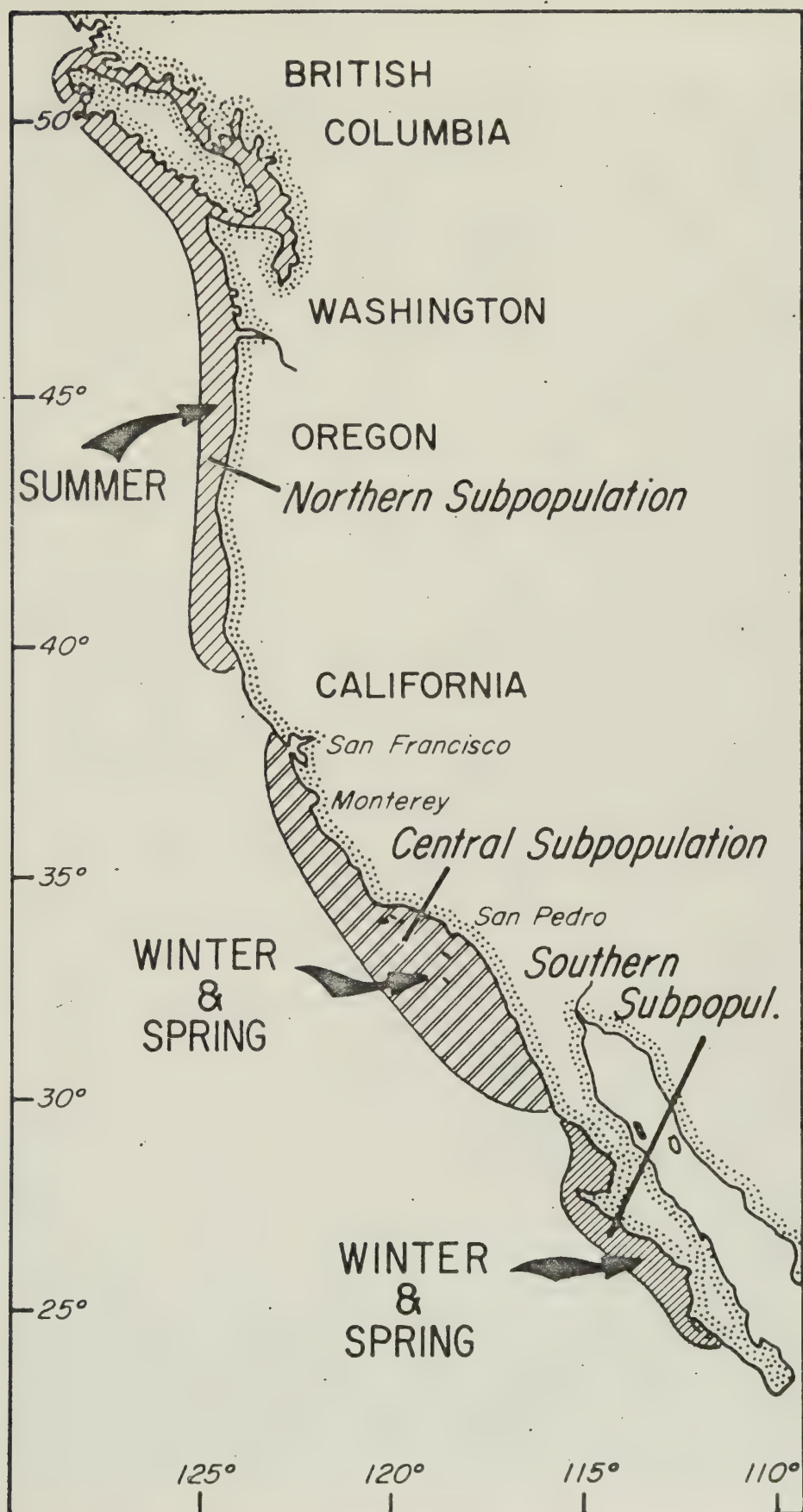
Table 1b. Commercial and bait catch analysis.

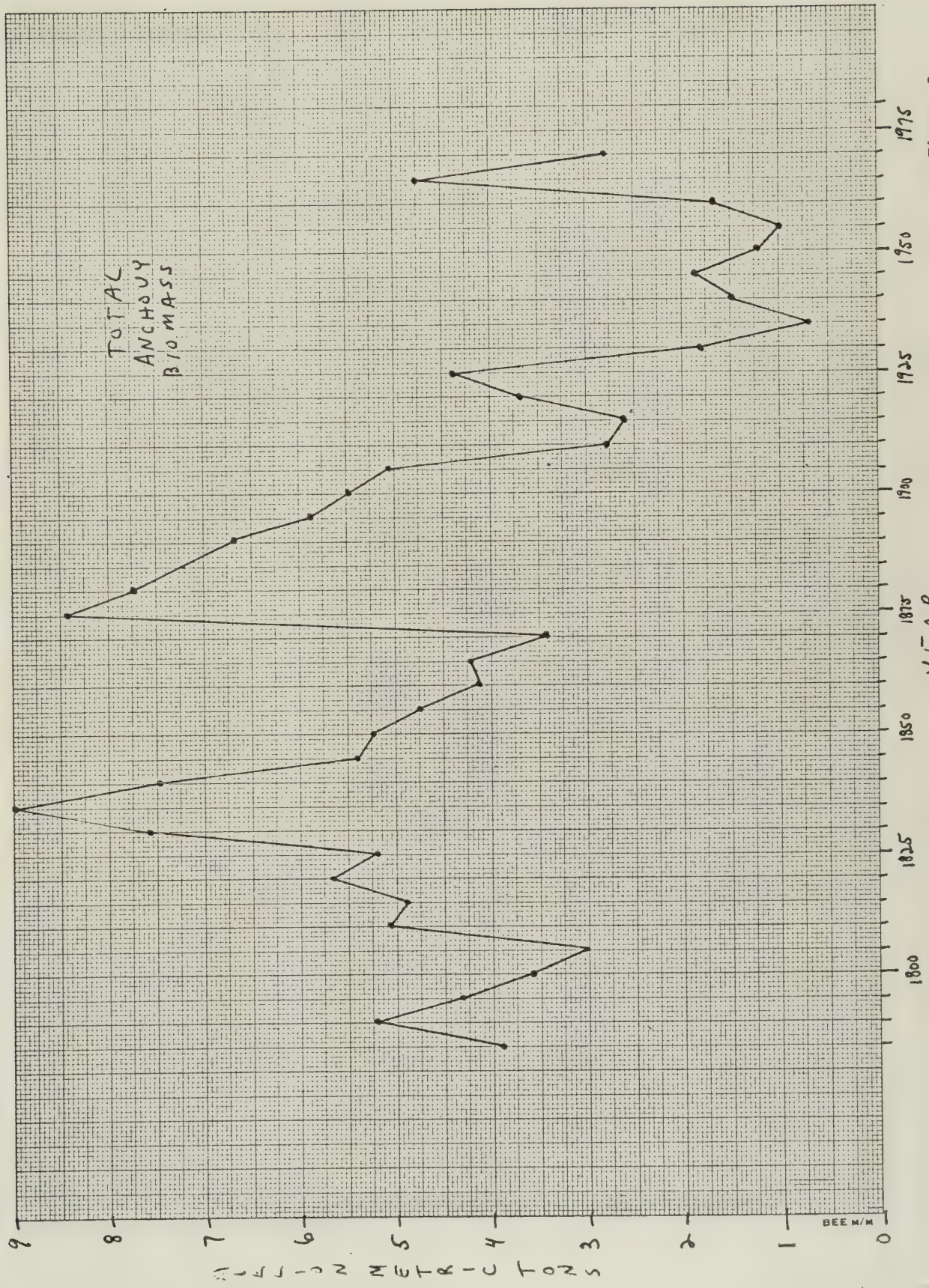
Season	% total catch					% selected catch			
	0	I	II	III	IV+	0	I	II	III
1952	13	11	31	26	19	.16	.14	.38	.32
3	17	31	35	14	3	.18	.32	.36	.14
4	13	52	29	6	0	.13	.52	.29	.06
5	6	52	34	8	0	.06	.52	.34	.08
6	2	24	59	14	1	.02	.24	.60	.14
7	2	48	39	10	1	.02	.48	.39	.10
8	11	62	25	2	0	.11	.62	.25	.02
9	69	21	9	1	0	.69	.21	.09	.01
1960	16	44	36	4	0	.16	.44	.36	.04
1	11	46	34	9	0	.11	.46	.34	.09
2	9	41	35	11	4	.09	.43	.36	.11
3	16	46	30	6	2	.16	.47	.31	.06
4	22	45	25	7	1	.22	.45	.25	.07
5	4	15	49	23	9	.04	.16	.54	.25
6	7	23	38	23	9	.08	.25	.42	.25
7	1	13	26	31	29	.01	.18	.37	.44
8	19	46	22	8	5	.20	.48	.23	.08
9	27	28	35	8	2	.28	.29	.36	.08
1970	4	32	40	20	4	.04	.33	.42	.21
1	11	51	27	8	3	.11	.53	.28	.08
2	10	26	48	14	2	.10	.27	.49	.14
3	7	20	35	31	7	.08	.22	.38	.33
4	5	19	40	26	10	.06	.21	.44	.29
5	2	11	38	34	15	.02	.13	.45	.40
6	28	12	16	28	16	.33	.14	.19	.33
1977	11	38	20	14	17	.13	.46	.24	.17
$\bar{x}$	13	33	33	15	6	(.14)	(.35)	(.35)	(.16)
$\bar{x}$						.14	.34	.35	.17
s						.14	.15	.11	.12
n						26	26	26	26

Table 2. Year class contribution to catch, ages "0" - III.

Season	Sea survey					Fishery				
	"0"	I	II	III	Total	"0"	I	II	III	Total
(.62) 1949				.08	.08/.13	(1.88)			.32	.32/.17
(.62) 1950			.22	.02	.24/.39	(1.00)		.38	.14	.52/.52
(.92) 1		.49	.17	.01	.67/.73	(.65)	.14	.36	.06	.56/.86
2	.21	.36	.03	.03	.63	.16	.32	.29	.08	.85
3	.45	.39	.31	.04	1.19	.18	.52	.34	.14	1.18
4	.57	.31	.33	0	1.21	.13	.52	.60	.10	1.35
5	.34	.12	.01	.04	.51	.06	.24	.39	.02	.71
6	.51	.19	.04	.02	.76	.02	.48	.25	.01	.76
7	.80	.74	.22	.07	1.83	.02	.62	.09	.04	.77
8	.18	.65	.48	.09	1.40	.11	.21	.36	.09	.77
9	.11	.36	.19	.06	.72	.69	.44	.34	.11	1.58
1960	.08	.42	.27	.30	1.07	.16	.46	.36	.06	1.04
1	.27	.38	.34	.26	1.25	.11	.43	.31	.07	.92
2	.28	.25	.31	.24	1.08	.09	.47	.25	.25	1.06
3	.11	.38	.34	.29	1.12	.16	.45	.54	.25	1.40
4	.05	.25	.34	.46	1.10	.22	.16	.42	.44	1.24
5	.18	.37	.19	.01	.75	.04	.25	.37	.08	.74
6	.01	.16	.45	.05	.67	.08	.18	.23	.08	.57
7	.19	.45	.22	.19	1.05	.01	.48	.36	.21	1.06
8	.09	.34	.36	.12	.91	.20	.29	.42	.08	.99
9	.38	.23	.37	.13	1.11	.28	.33	.28	.14	1.03
1970	.23	.48	.37	.35	1.43	.04	.53	.49	.33	1.39
1	.03	.45	.40	.39	1.27	.11	.27	.38	.29	1.05
2	.03	.18	.39	.16	.77	.10	.22	.44	.40	1.16
3	.07	.15	.33	.08	.63	.08	.21	.45	.33	1.07
4	.07	.09	.04	.07	.27	.06	.13	.19	.17	.55
5	.27	.07	.10	(T)	.44	.02	.14	.24	(.48)	.40/.83
(1.95) 1976	.80	.68	(.20)		1.68/.86	.33	.46		(1.65)	.79/.48
(.50) 1977	.14	(.16)			.30/.60	.13			(.93)	.13/.14
(2.42) 1978	(.63)				.63/.26					
1979										
MAX	2.42					1.88				
MIN	.27					.48				
	2.15					1.40				

Figure 1.





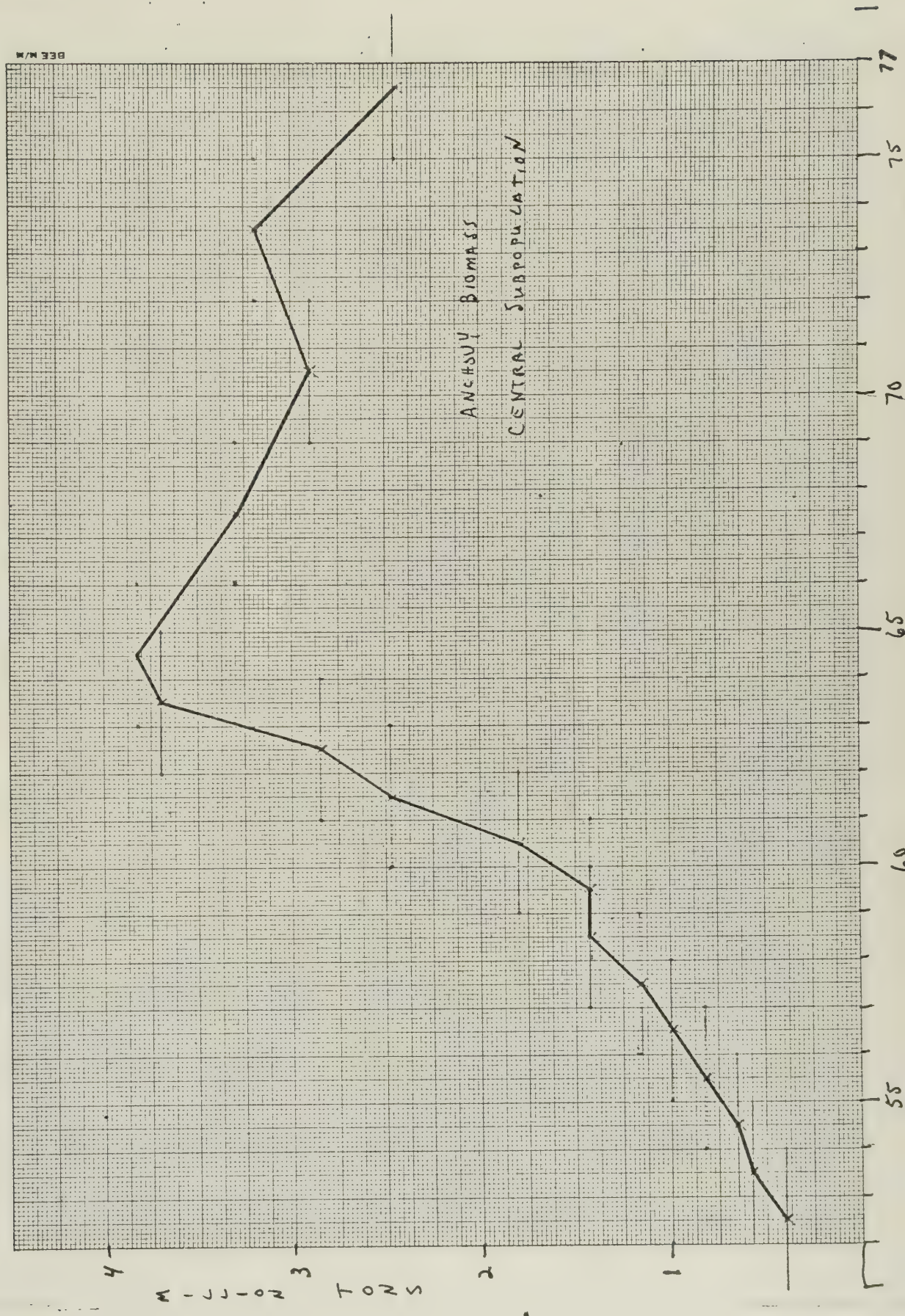


Figure 4.

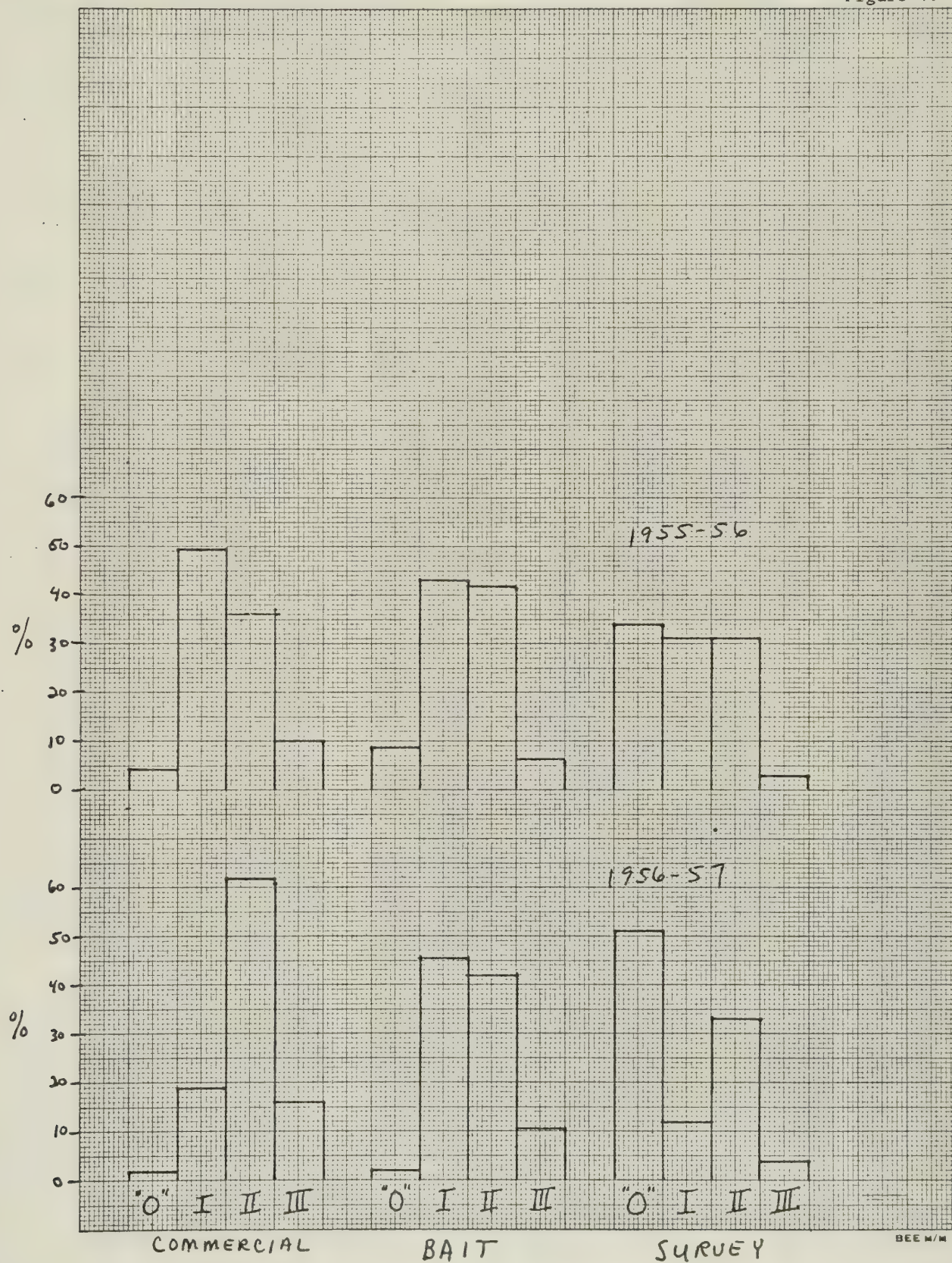


Figure 5.

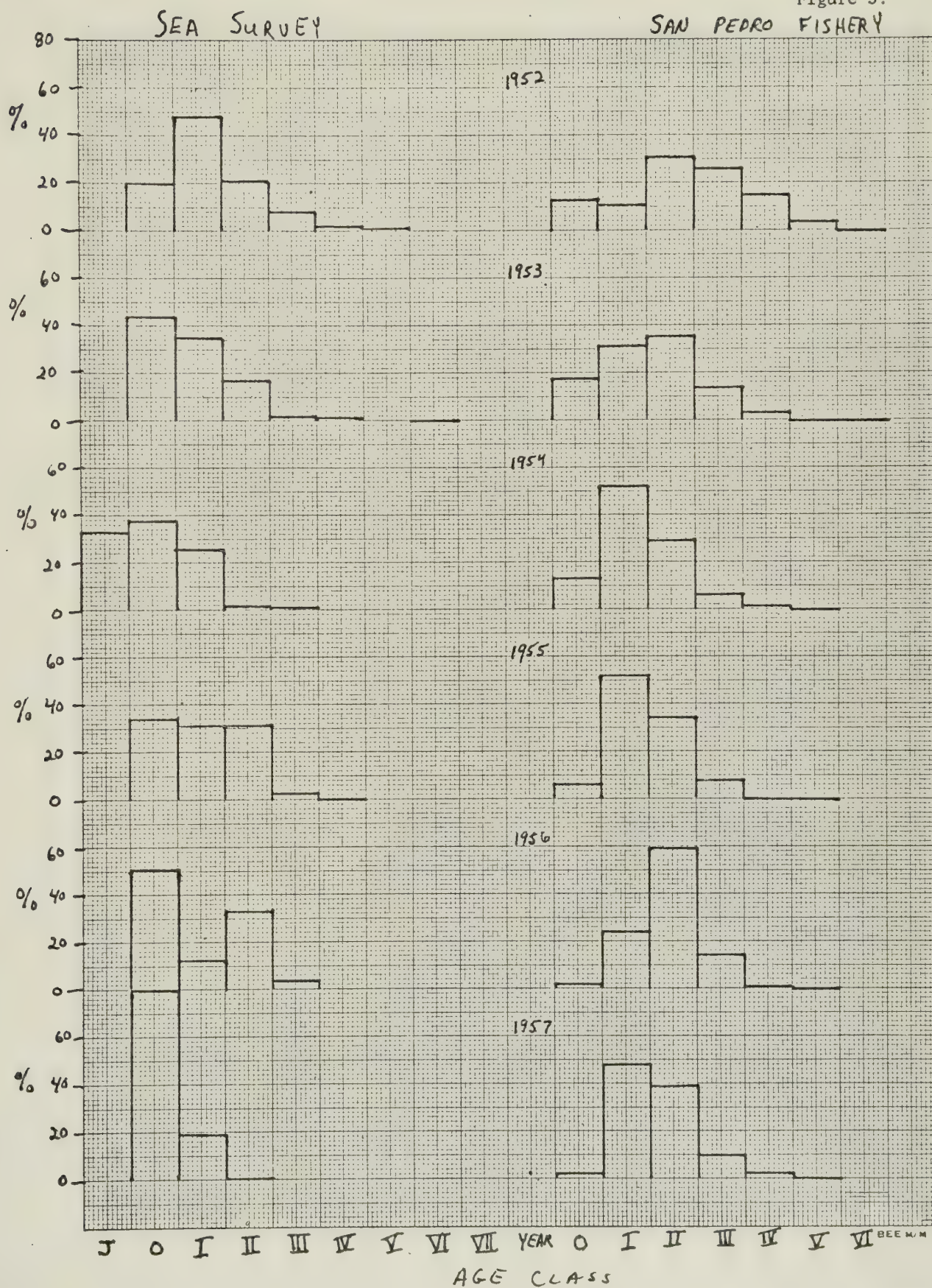


Figure 5 (cont.)

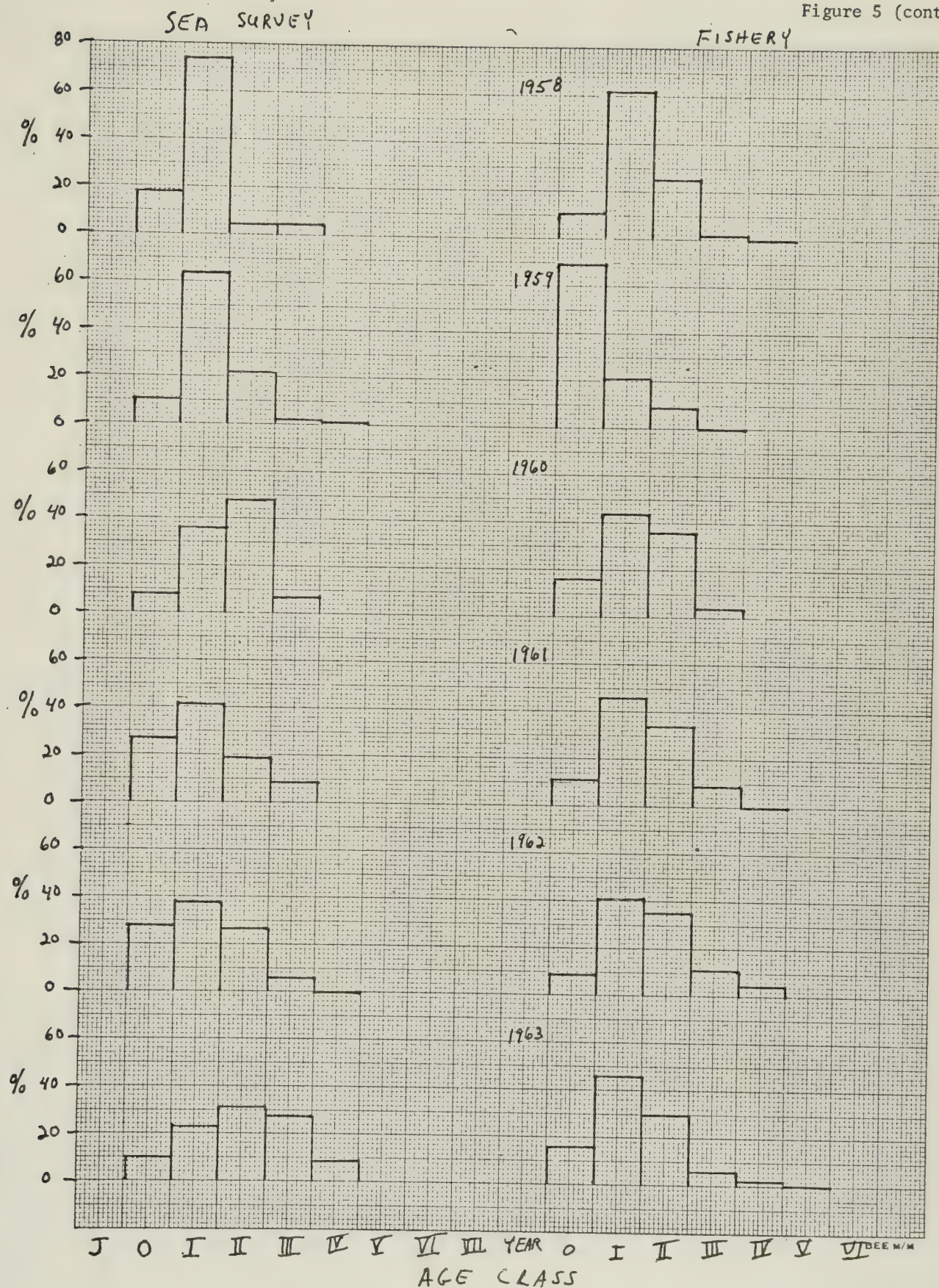


Figure 5. (cont.)

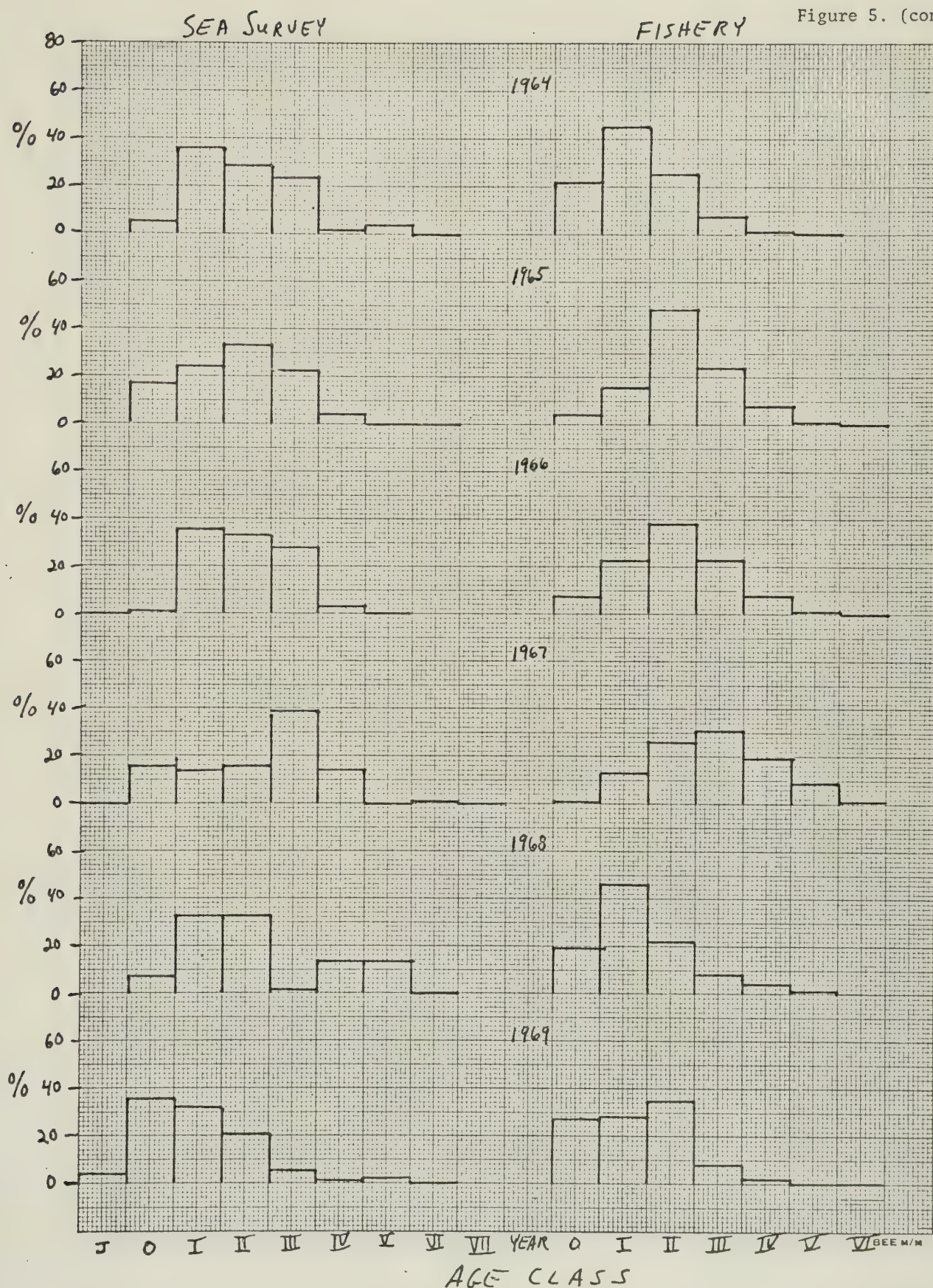


Figure 5. (cont.)

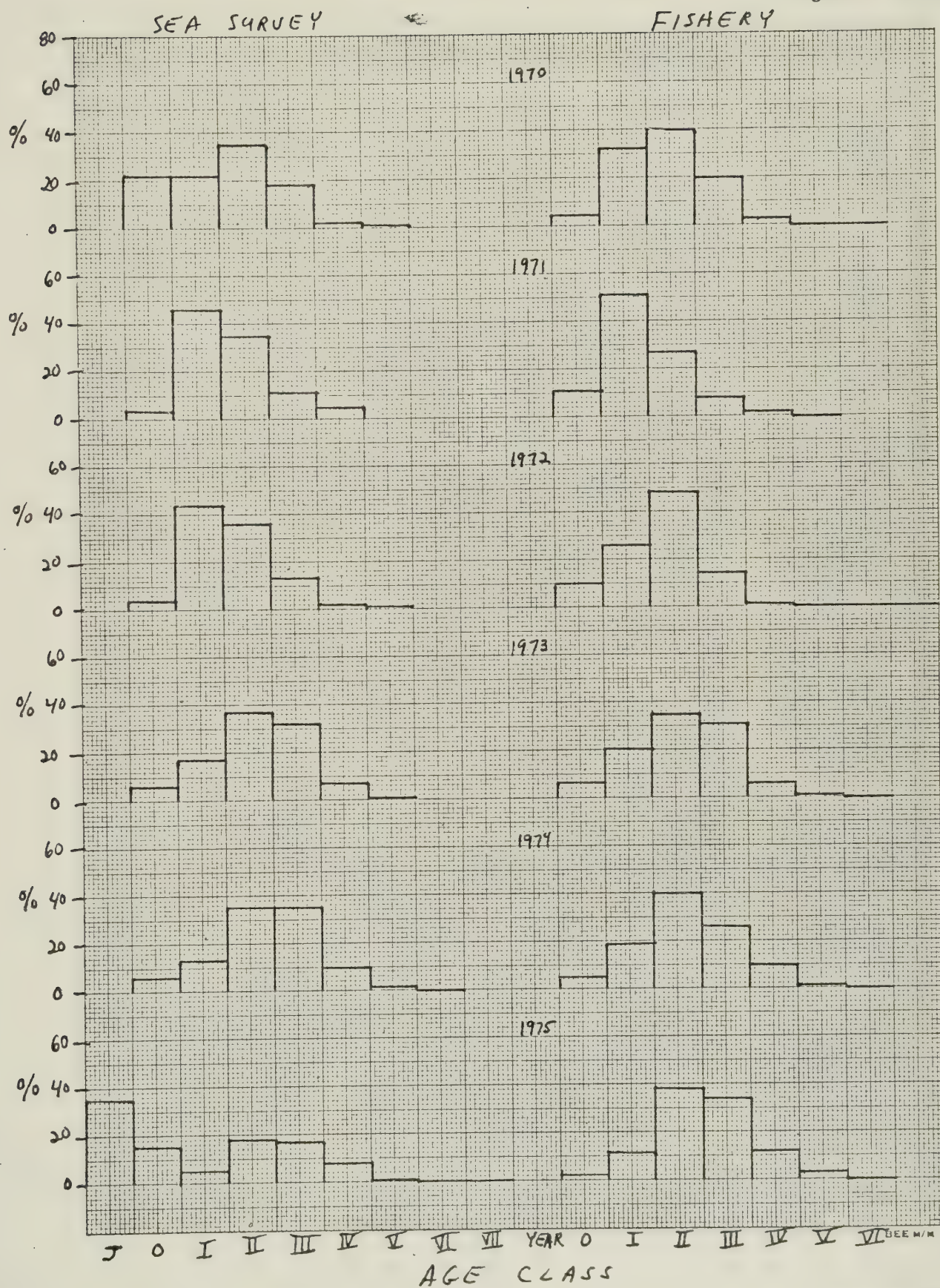
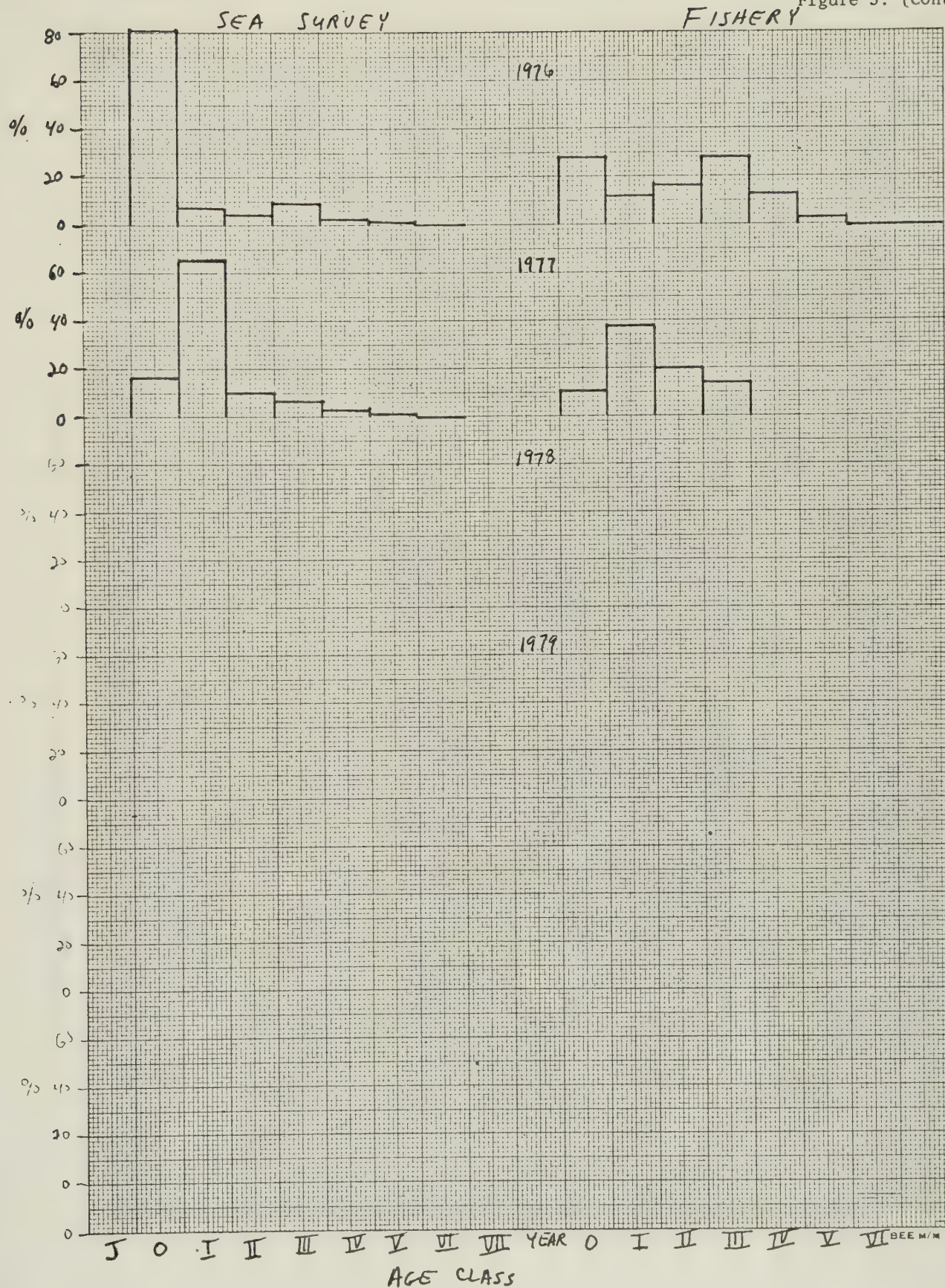
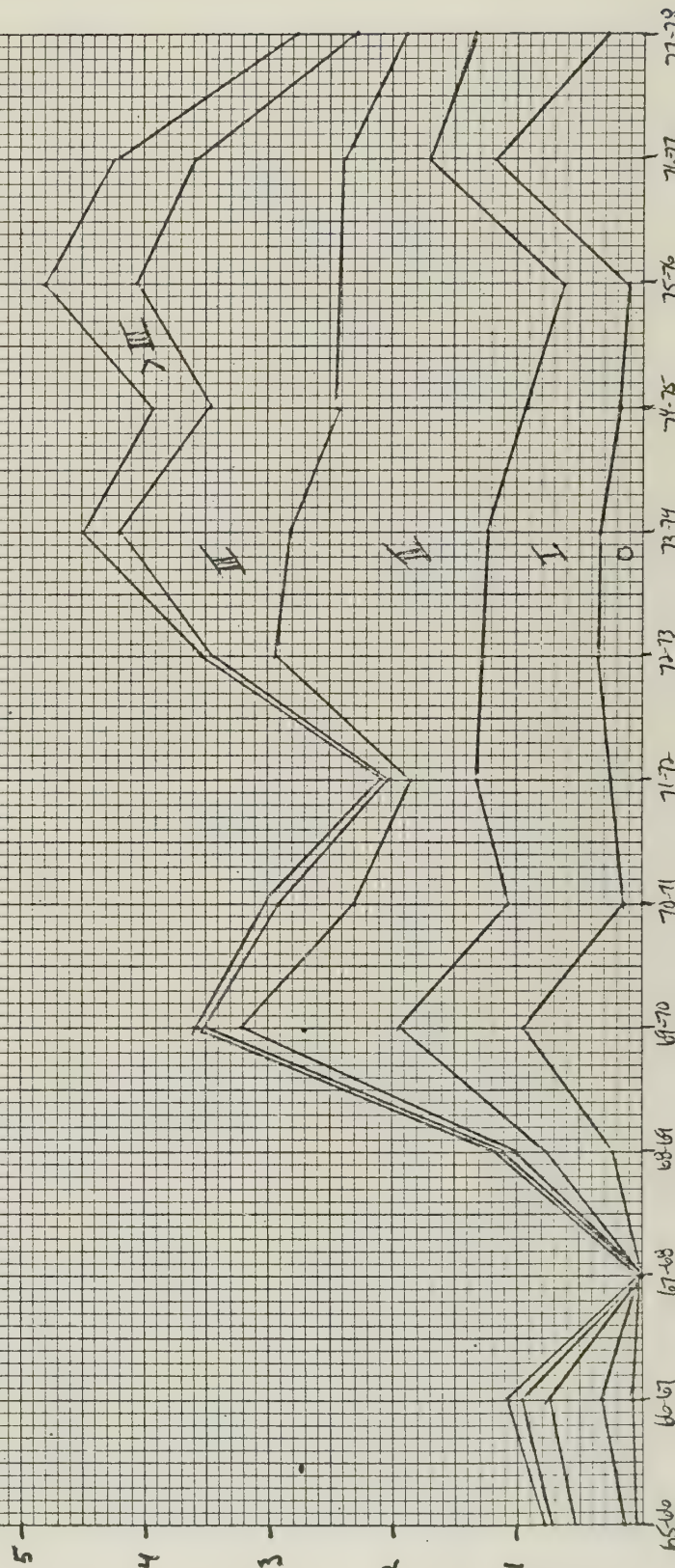


Figure 5. (cont.)

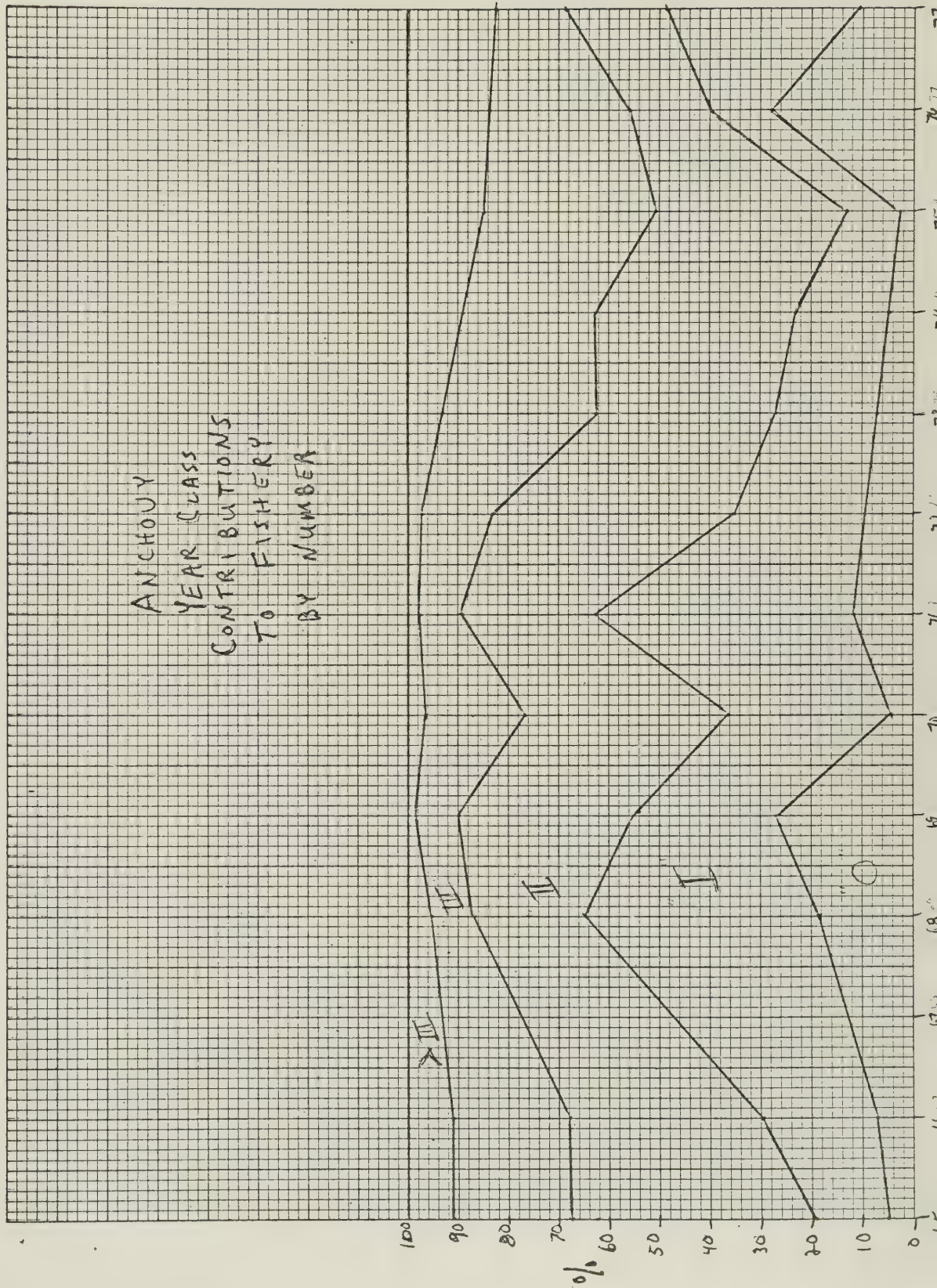


ANCHOR
YEAR CLASS
CONTRIBUTIONS
TO FISHERY
BY NUMBER

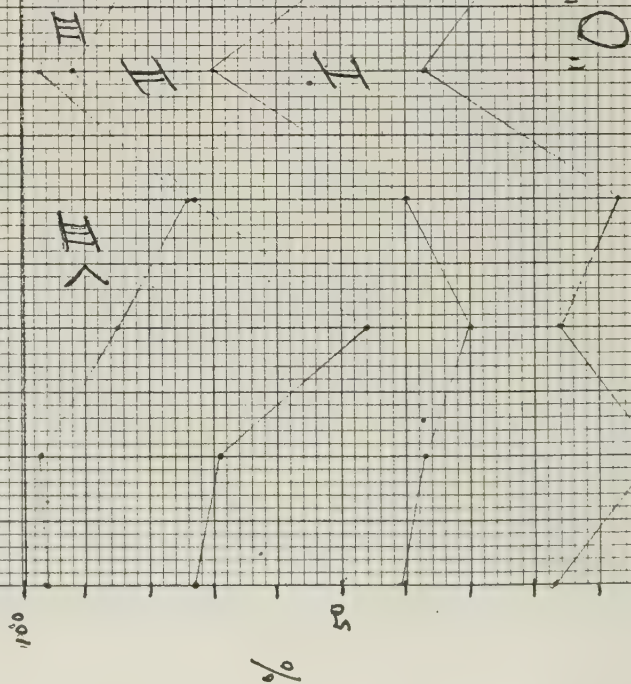
5
4
3
2
1
0
P I L L I O N S

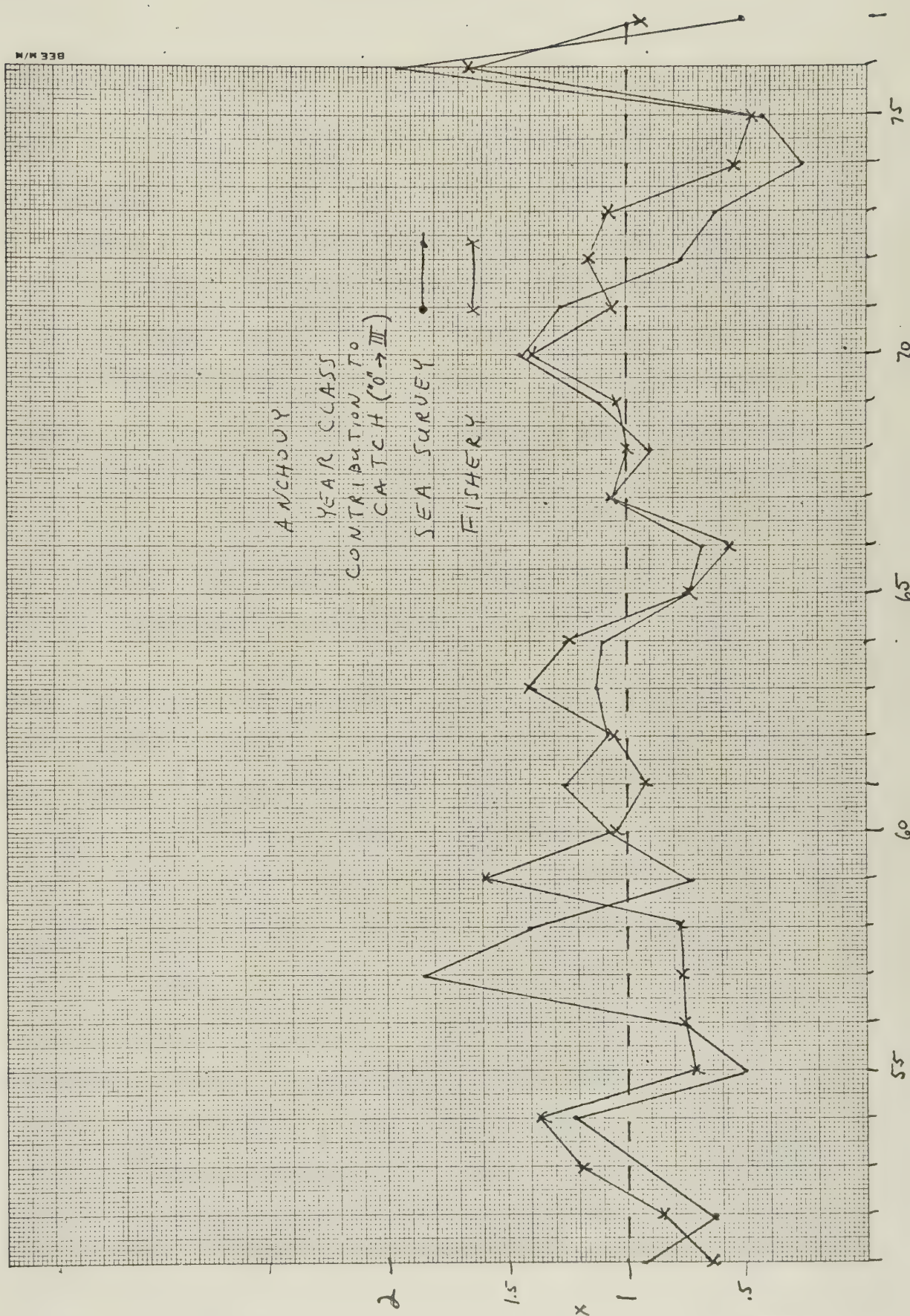


ANCHOUY
YEAR CLASS
CONTRIBUTIONS
TO FISHERY
BY NUMBER



ANCHOUY
YEAR CLASS
CONTRIBUTIONS
TO SURVIVAL
BY NUMBER





APPENDIX

Method of Assembly

Each aged catch (usually 10 fish) was partitioned by multiplying the proportion of the aged fish of a given year class times the catch of anchovies in that trawl. All cruises from July 1 of a year to June 30 of the following year were combined so the survey season would cover the same time period as the fishing season. Proportions were determined from the total of each year-class for the survey season. For each cruise there was an accounting of the total stations, the number and proportion of the stations containing anchovy, the age of the fish of that year class assuming a birthdate of March 1, and a date of capture at the mid-date of the cruise. In Appendix Table A, I have listed all the cruise numbers, the cruise identifiers (year, month) and the year-classes captured on each cruise.

In Appendix Table B, I have listed the year-classes and certain data regarding the estimated abundance. The first column is the cruise identifier, the second column is the number of stations on the cruise in which the appropriate samples were taken, the third column is the number of samples which contain anchovy of any age, the fourth column is the ratio of stations containing anchovy to the total, the fifth column is the estimated days old a fish of this year class would be were it spawned on March 1, the sixth column is the number of samples which were aged, the seventh column is the number of samples which were aged which contained anchovy of this year-class, the eighth column is the proportion of samples containing anchovy which were aged which also contained a specimen of this year-class, and the ninth column is the number of anchovy of this year-class per aged sample.

Appendix Table A. Incidence of year classes of northern anchovy on sea survey cruises.

Cruise #	I.D.	47/48	49/50	51/52	53/54	55/56	57/58	59/60	61/62	63/64	65/66	67/68	69/70	71/72	73/74	75/76	77
8374	5304	X	X	X	X	X											
7	5308					X											
8	5309			X	X	X	X										
9	5310	X		X	X	X	X										
10	5310-1			X													
8472	5402				X	X											
6	5406				X	X											
7	5408			X	X	X	X										
10	5410			X	X	X	X										
11	5411			X	X	X	X										
8572	5503			X	X	X	X										
4	5505				X	X	X	X									
8	5507			X	X	X	X	X									
7	5509				X	X	X	X	X								
8	5510				X	X	X	X	X								
9	5511				X	X	X	X	X								
8655	5609					X	X	X									
6	5610				X	X	X	X									
7	5611				X	X	X	X									
8	5612					X	X	X									
8851	5802					X	X	X									
2	5803					X											
A1	5804						X	X									
2	5805						X	X									
59A1	5902						X	X	X								
2	5903						X	X	X								
3	5904						X	X	X								
4	5905						X	X	X								
7	5909						X	X	X	X							
8	5910					X	X	X	X	X							
9	5911						X	X	X	X							
60A3	6003						X	X	X	X							
7	6008						X	X	X	X							
9	6010						X	X	X	X							
10	6011						X	X	X	X							
61A3	6104						X	X	X	X							
7	6110						X	X	X	X							
8	6111						X	X	X	X							
62A6	6210						X	X	X	X							
7	6211						X	X	X	X	X						
63A5	6308						X	X	X	X	X						
6	6309						X	X	X	X	X						
7	6310						X	X	X	X	X						
64A4	6406						X	X	X	X	X						
8	6408						X	X	X	X	X						
6	6409						X	X	X	X	X						
7	6410						X	X	X	X	X						
8	6411						X	X	X	X	X						
9	6412						X	X	X	X	X						
65A2	6504						X	X	X	X	X						
3	6504-1						X	X	X	X	X						
6	6507						X	X	X	X	X						
7	6508						X	X	X	X	X						
8	6509						X	X	X	X	X						
9	6510						X	X	X	X	X						
10	6511						X	X	X	X	X						
66A7	6609						X	X	X	X	X						
8	6610						X	X	X	X	X						
9	6611						X	X	X	X	X						
67A2	6704						X	X	X	X	X						
4	6706						X	X	X	X	X						
6	6706-1						X	X	X	X	X						
7	6710						X	X	X	X	X						
8	6711						X	X	X	X	X						
9	6711-1						X	X	X	X	X						
68A1	6801						X	X	X	X	X						
2	6802						X	X	X	X	X						
3	6803						X	X	X	X	X						
4	6809						X	X	X	X	X						
7	6808						X	X	X	X	X						
8	6809						X	X	X	X	X						
9	6811						X	X	X	X	X						
69A5	6905						X	X	X	X	X						
8	6908						X	X	X	X	X						
11	6911						X	X	X	X	X						
70A1	7002						X	X	X	X	X						
4	7006						X	X	X	X	X						
6	7009						X	X	X	X	X						
7	7010						X	X	X	X	X						
71A1	7102						X	X	X	X	X						
3	7104						X	X	X	X	X						
6	7108						X	X	X	X	X						
7	7109						X	X	X	X	X						
9	7111						X	X	X	X	X						
72A3	7204						X	X	X	X	X						
8	7210						X	X	X	X	X						
9	7211						X	X	X	X	X						
73A2	7303						X	X	X	X	X						
3	7305						X	X	X	X	X						
6	7308						X	X	X	X	X						
8	7310						X	X	X	X	X						
74A3	7404						X	X	X	X	X						
8	7410						X	X	X	X	X						
9	7411						X	X	X	X	X						
75A1	7502						X	X	X	X	X						
2	7504						X	X	X	X	X						
8	7509						X	X	X	X	X						
6	7510						X	X	X	X	X						
7	7511						X	X	X	X	X						
76A3	7604						X	X	X	X	X						
48	7606						X	X	X	X	X						
7	7609						X	X	X	X	X						
8	7610						X	X	X	X	X						
9	7611						X	X	X	X	X						
77A1	7701						X	X	X	X	X						
3	7702						X	X	X	X	X						
6	7704						X	X	X	X	X						
12	7710						X	X	X	X	X						
13	7711						X	X	X	X	X						

Appendix Table B.

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1947</u>								
5304	50	21	0.42	2219	17	1	0.06	0.90
5310-1	30	24	0.80	2388	20	1	0.05	0.04
<u>YEAR CLASS 1948</u>								
5304	50	21	0.42	1854	17	3	0.18	1.67
<u>YEAR CLASS 1949</u>								
5304	50	21	0.42	1489	17	5	0.29	5.86
5310-1	30	24	0.80	1658	20	1	0.05	2.38
<u>YEAR CLASS 1950</u>								
5304	50	21	0.42	1123	17	10	0.59	15.19
5309	78	27	0.35	1272	9	2	0.22	5.48
5310-1	30	24	0.80	1292	20	4	0.20	1.08
<u>YEAR CLASS 1951</u>								
5304	50	21	0.42	758	17	14	0.82	35.52
5309	78	27	0.35	907	9	4	0.44	12.19
5310-1	30	24	0.80	927	20	16	0.80	35.75
5310-2	17	5	0.29	957	2	1	0.50	0.40
5408	29	7	0.24	1237	5	4	0.80	18.29
5410	90	7	0.08	1319	5	2	0.40	3.43
5503	49	16	0.33	1458	13	1	0.08	0.25
5507	51	14	0.27	1527	13	2	0.15	2.21
<u>YEAR CLASS 1952</u>								
5304	50	21	0.42	393	17	8	0.47	14.67
5309	78	27	0.35	542	9	5	0.56	26.67
5310-1	30	24	0.80	562	20	15	0.75	40.54
5402	61	7	0.11	690	3	2	0.67	7.57
5406	41	17	0.41	810	2	1	0.50	42.00
5408	29	7	0.24	872	5	5	1.00	18.29
5410	90	7	0.08	954	5	3	0.60	32.71
5411	63	14	0.22	984	6	2	0.33	1.07
5503	49	16	0.33	1093	13	1	0.08	0.50
5507	51	14	0.27	1223	13	7	0.54	31.43
5510	135	17	0.13	1308	15	2	0.13	0.41

(continued)

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1953</u>								
5308	84	7	0.08	145	1	1	1.00	14.29
5309	78	27	0.35	177	9	8	0.89	45.30
5310-1	30	24	0.80	197	20	13	0.65	44.96
5310-2	17	5	0.29	226	2	2	1.00	55.20
5402	61	7	0.11	325	3	3	1.00	12.29
5406	41	17	0.41	445	2	2	1.00	16.94
5408	29	7	0.24	506	5	4	0.80	279.14
5410	90	7	0.08	588	5	5	1.00	27.71
5411	63	14	0.22	619	6	2	0.33	31.21
5503	49	16	0.33	362	13	6	0.46	177.19
5505	56	7	0.13	805	2	2	1.00	88.57
5507	51	14	0.27	858	13	11	0.85	277.21
5509	80	12	0.15	913	3	2	0.67	70.00
5510	135	17	0.13	943	15	8	0.53	13.47
5511	69	6	0.09	970	5	2	0.40	15.83
5610	103	7	0.07	1297	4	1	0.25	9.00
5611	74	6	0.08	1327	5	4	0.80	48.00
<u>YEAR CLASS 1954</u>								
5408	29	7	0.24	141	5	1	0.20	6.43
5410	90	7	0.08	223	5	1	0.20	0.29
5411	63	14	0.22	254	6	5	0.83	100.64
5503	49	16	0.33	362	13	11	0.85	290.44
5505	56	7	0.13	439	2	1	0.50	2.00
5507	51	14	0.27	493	13	11	0.85	280.64
5509	80	12	0.15	548	3	1	0.33	1.08
5510	135	17	0.13	577	15	9	0.60	33.18
5511	69	6	0.09	605	5	2	0.40	99.00
5610	103	7	0.07	932	4	4	1.00	325.00
5611	74	6	0.08	961	5	3	0.60	48.17
<u>YEAR CLASS 1955</u>								
5505	56	7	0.13	74	2	1	0.50	771.43
5507	51	14	0.27	127	13	5	0.38	23.29
5509	80	12	0.15	183	3	3	1.00	62.33
5510	135	17	0.13	212	15	13	0.87	250.06
5511	69	6	0.09	240	5	3	0.60	42.33
5609	78	11	0.14	536	1	1	1.00	4.55
5610	103	7	0.07	566	4	2	0.50	12.57
5611	74	6	0.08	596	5	3	0.60	129.50
5802	73	8	0.11	1130	4	2	0.50	6.25
5803	76	11	0.14	1160	8	2	0.25	9.82
5910	114	19	0.17	1658	11	1	0.09	14.63

(continued)

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1956</u>								
5507	78	11	0.14	171	1	1	1.00	4.55
5612	73	2	0.03	260	1	1	1.00	2000.00
5802	57	3	0.05	704	2	2	1.00	59.67
5804	73	8	0.11	765	4	3	0.75	18.75
5805	76	11	0.14	795	8	5	0.63	206.64
5902	62	12	0.19	1055	2	1	0.50	150.00
5903	86	10	0.12	1088	4	1	0.25	3.30
5904	82	12	0.15	1117	4	1	0.25	170.83
5910	114	19	0.17	1292	11	1	0.09	29.26
6003	66	4	0.06	1472	3	1	0.33	27.75
6111	109	13	0.12	2062	8	2	0.25	8.92
<u>YEAR CLASS 1957</u>								
5802	57	3	0.05	339	2	2	1.00	77.73
5804	73	8	0.11	400	4	2	0.50	67.63
5805	76	11	0.14	429	8	8	1.00	954.00
5902	62	12	0.19	690	2	2	1.00	355.00
5903	86	10	0.12	723	4	4	1.00	980.80
5904	82	12	0.15	752	4	3	0.75	406.67
5905	88	13	0.15	782	6	6	1.00	1427.31
5909	71	18	0.25	898	6	5	0.83	134.50
5910	114	19	0.17	927	11	6	0.55	209.32
5911	83	13	0.16	959	4	3	0.75	5.69
6003	66	4	0.06	1107	3	2	0.67	64.50
6008	78	10	0.13	1254	1	1	1.00	40.00
6011	94	6	0.06	1339	2	2	1.00	39.33
6110	91	9	0.10	1670	1	1	1.00	7.44
6111	109	13	0.12	1697	8	2	0.25	14.46
<u>YEAR CLASS 1958</u>								
5902	62	12	0.19	325	2	2	1.00	295.00
5903	86	10	0.12	357	4	2	0.50	275.80
5904	82	12	0.15	387	4	1	0.25	250.00
5909	71	18	0.25	532	6	6	1.00	225.39
5910	114	19	0.17	562	11	10	0.91	399.32
5911	83	13	0.16	594	4	4	1.00	148.92
6003	66	4	0.06	742	3	3	1.00	1476.50
6008	78	10	0.13	889	1	1	1.00	200.00
6010	119	6	0.05	946	2	2	1.00	70.00
6011	94	6	0.06	973	2	2	1.00	78.50
6104	79	2	0.03	1124	1	1	1.00	643.00
6110	91	9	0.10	1305	1	1	1.00	44.44
6111	109	13	0.12	1332	8	4	0.50	48.85
6211	83	15	0.18	1717	7	1	0.14	66.67
6412	65	20	0.31	2456	13	1	0.08	0.15

(continued)

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1959</u>								
5909	71	19	0.25	167	6	1	0.17	77.94
5910	114	19	0.17	197	11	1	0.09	0.68
5911	83	13	0.16	229	4	1	0.25	0.77
6003	66	4	0.06	376	3	3	1.00	506.25
6010	119	6	0.05	580	2	2	1.00	120.00
6011	94	6	0.06	608	2	2	1.00	122.17
6104	79	2	0.03	759	1	1	1.00	857.00
6110	91	9	0.10	940	1	1	1.00	14.78
6111	109	13	0.12	966	8	4	0.50	161.08
6210	70	15	0.21	1321	2	1	0.50	73.33
6211	83	15	0.18	1352	7	1	0.14	833.33
6309	57	28	0.49	1644	3	1	0.33	11.79
6310	56	31	0.55	1672	7	5	0.71	103.16
6411	93	47	0.51	2060	17	3	0.18	767.38
6412	65	20	0.31	2091	13	1	0.08	2.20
6504-1	21	18	0.86	2231	8	2	0.25	3.67
6511	50	33	0.66	2445	13	1	0.08	0.61
<u>YEAR CLASS 1960</u>								
6010	119	6	0.05	215	2	2	1.00	110.00
6011	94	6	0.06	243	2	1	0.50	11.67
6111	109	13	0.12	601	8	7	0.88	369.77
6210	70	15	0.21	956	2	2	1.00	826.67
6211	83	15	0.18	986	7	4	0.57	3076.67
6310	56	31	0.55	1307	7	7	1.00	292.77
6406	57	22	0.39	1547	2	1	0.50	36.36
6409	61	30	0.49	1634	13	2	0.15	13.63
6410	72	32	0.44	1663	11	5	0.45	76.03
6411	93	47	0.51	1695	17	6	0.35	88.40
6412	65	20	0.31	1725	13	10	0.77	420.85
6504-1	21	18	0.86	1866	8	2	0.25	10.50
6508	40	14	0.35	1987	7	2	0.29	37.64
6510	86	30	0.35	2047	5	1	0.20	1.93
6511	50	33	0.66	2080	13	1	0.08	0.61
6710	120	22	0.18	2758	6	1	0.17	0.23

(continued)

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1961</u>								
6111	109	13	0.12	236	8	4	0.50	234.77
6210	70	15	0.21	590	2	1	0.50	73.33
6211	83	15	0.18	621	7	7	1.00	5486.67
6308	69	16	0.23	884	1	1	1.00	278.63
6309	57	28	0.49	913	3	3	1.00	13.36
6310	56	31	0.55	942	7	6	0.86	187.81
6404	57	22	0.39	1182	2	1	0.50	36.36
6408	66	27	0.41	1238	2	1	0.50	13.22
6409	61	30	0.49	1268	13	3	0.23	54.73
6410	72	32	0.44	1298	11	7	0.64	184.59
6411	93	47	0.51	1330	17	14	0.82	3325.89
6412	65	20	0.31	1360	13	12	0.92	2116.90
6504	5	4	0.80	1481	1	1	1.00	33.25
6504-1	21	18	0.86	1501	8	7	0.88	83.72
6507	53	18	0.34	1596	5	1	0.20	2.33
6508	40	14	0.35	1622	7	1	0.14	32.86
6509	82	49	0.60	1653	16	4	0.25	417.35
6510	86	30	0.35	1682	5	4	0.80	42.20
6511	50	33	0.66	1715	13	7	0.54	15.85
6706-1	89	3	0.03	2296	3	1	0.33	6.67
6710	120	22	0.18	2393	6	1	0.17	6.55
<u>YEAR CLASS 1962</u>								
6211	83	15	0.18	256	7	4	0.57	4110.00
6308	69	16	0.23	518	1	1	1.00	78.63
6310	56	31	0.55	576	7	5	0.71	106.10
6406	57	22	0.39	816	2	1	0.50	36.36
6408	66	27	0.41	873	2	2	1.00	70.81
6409	61	30	0.49	903	13	8	0.62	1824.47
6410	72	32	0.44	933	11	10	0.91	234.00
6411	93	47	0.51	964	17	17	1.00	3949.68
6412	65	20	0.31	995	13	9	0.69	225.40
6504	5	4	0.80	1115	1	1	1.00	133.25
6504-1	21	18	0.86	1135	8	8	1.00	148.00
6507	53	18	0.34	1231	5	5	1.00	2157.72
6508	40	14	0.35	1257	7	4	0.57	220.50
6509	82	49	0.60	1287	16	12	0.75	1689.33
6510	86	30	0.35	1317	5	5	1.00	90.77
6511	50	33	0.66	1350	13	11	0.85	91.94
6610	168	28	0.17	1671	15	5	0.33	25.32
6611	135	29	0.21	1702	8	5	0.63	46.83
6704	158	30	0.19	1850	19	2	0.11	1.03
6706	150	11	0.07	1901	7	2	0.29	3.36
6706-1	89	3	0.03	1931	1	1	1.00	6.67
6710	120	22	0.18	2027	6	1	0.17	0.23
6804	228	54	0.24	2234	16	4	0.25	1.46
6808	157	4	0.03	2345	2	1	0.50	15.25

(continued)

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1963</u>								
6308	69	16	0.23	153	1	1	1.00	111.44
6310	56	31	0.55	211	7	1	0.14	2.52
6406	57	22	0.39	451	2	2	1.00	86.36
6408	66	27	0.41	507	2	2	1.00	219.04
6409	61	30	0.49	538	13	11	0.85	6408.20
6410	72	32	0.44	567	11	7	0.64	158.25
6411	93	47	0.51	599	17	11	0.65	2208.79
6412	65	20	0.31	630	13	4	0.31	15.35
6504	5	4	0.80	750	1	1	1.00	266.75
6504-1	21	18	0.86	770	8	8	1.00	129.11
6507	53	18	0.34	866	5	5	1.00	3566.78
6508	40	14	0.35	892	7	3	0.43	94.79
6509	82	49	0.60	922	16	14	0.88	2498.53
6510	86	30	0.35	952	5	4	0.80	13.30
6511	50	33	0.66	984	13	10	0.77	77.39
6609	145	24	0.17	1273	7	2	0.29	375.17
6610	168	28	0.17	1306	15	12	0.80	39.75
6611	135	29	0.21	1337	8	8	1.00	125.83
6704	158	30	0.19	1485	19	12	0.63	100.73
6506	150	11	0.07	1536	7	5	0.71	30.36
6506-1	89	3	0.03	1566	3	2	0.67	34.67
6710	120	22	0.18	1662	6	6	1.00	105.55
6801	140	17	0.12	1778	12	2	0.17	3.35
6802	98	21	0.21	1809	8	2	0.25	19.38
6804	228	54	0.24	1869	16	10	0.63	5.22
6808	157	4	0.03	1979	2	1	0.50	138.00
6809	216	61	0.28	2023	7	2	0.29	245.98
6905	64	58	0.91	2278	30	3	0.10	1.40

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1964</u>								
6408	66	27	0.41	142	2	1	0.50	64.19
6409	61	30	0.49	173	13	5	0.38	813.33
6411	93	47	0.51	234	17	3	0.18	385.15
6412	65	20	0.31	264	13	2	0.15	16.05
6504	5	4	0.80	385	1	1	1.00	66.75
6504-1	21	18	0.86	405	8	2	0.25	14.44
6507	53	18	0.34	501	5	3	0.60	1287.06
6508	40	14	0.35	526	7	3	0.43	6060.71
6509	82	49	0.60	557	16	6	0.38	551.76
6510	86	30	0.35	586	5	2	0.40	5.10
6511	50	33	0.66	619	13	3	0.23	10.94
6609	145	24	0.17	908	7	5	0.71	585.63
6610	168	28	0.17	941	15	13	0.87	27.75
6611	135	29	0.21	971	8	7	0.88	72.00
6704	158	30	0.19	1119	19	17	0.89	119.30
6706	150	11	0.07	1171	7	7	1.00	35.09
6706-1	89	3	0.03	1201	3	2	0.67	51.00
6710	120	22	0.18	1297	6	5	0.83	308.27
6801	140	17	0.12	1413	12	7	0.58	19.41
6802	98	21	0.21	1443	8	3	0.38	19.38
6803	148	22	0.15	1473	11	2	0.18	0.55
6804	228	54	0.24	1504	16	13	0.81	13.20
6808	157	4	0.03	1614	2	2	1.00	155.00
6809	216	61	0.28	1658	7	5	0.71	173.18
6811	173	17	0.10	1703	12	6	0.50	224.35
6905	64	58	0.91	1912	30	7	0.23	14.60
6908	59	48	0.81	1996	30	3	0.10	1.80
6911	57	44	0.77	2094	23	1	0.40	146.70
7002	46	40	0.87	2166	25	2	0.80	12.00

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1965</u>								
6508	40	14	0.35	161	7	2	0.29	5821.43
6509	82	49	0.60	192	16	3	0.19	285.69
6510	86	30	0.35	221	5	2	0.40	3.00
6511	50	33	0.66	254	13	1	0.08	0.21
6609	145	24	0.17	543	7	5	0.71	791.50
6610	168	28	0.17	575	15	5	0.33	2.89
6611	135	29	0.21	606	8	2	0.25	46.83
6704	158	30	0.19	754	19	10	0.53	53.37
6706	150	11	0.07	806	7	5	0.71	24.91
6706-1	89	3	0.03	835	3	2	0.67	56.33
6710	120	22	0.18	932	6	2	0.33	58.41
6711	137	27	0.20	961	1	1	1.00	0.70
6711-1	112	31	0.28	991	2	1	0.50	0.10
6801	140	17	0.12	1048	12	8	0.67	26.94
6802	98	21	0.21	1078	8	7	0.88	16.19
6803	148	22	0.15	1108	11	8	0.73	19.18
6804	228	54	0.24	1138	16	14	0.88	16.63
6809	216	61	0.28	1292	7	4	0.57	5.23
6811	173	17	0.10	1338	12	6	0.50	56.65
6905	64	58	0.91	1547	30	16	0.53	50.60
6908	59	48	0.81	1631	30	6	0.20	22.50
6911	57	44	0.77	1729	23	5	0.22	7.50
7002	46	40	0.87	1801	25	4	0.16	22.60
7006	46	40	0.87	1919	26	5	0.19	21.60
7010	44	36	0.82	2049	20	2	0.10	45.80
<u>YEAR CLASS 1966</u>								
6609	145	24	0.17	178	7	1	0.14	17.71
6704	158	30	0.19	389	19	7	0.37	9.03
6706	150	11	0.07	440	7	1	0.14	6.09
6706-1	89	3	0.03	470	3	1	0.33	14.67
6711	137	27	0.20	596	1	1	1.00	0.37
6711-1	112	31	0.28	626	2	2	1.00	0.84
6801	140	17	0.12	682	12	9	0.75	49.94
6802	98	21	0.21	713	8	6	0.75	24.81
6803	148	22	0.15	743	11	8	0.73	28.45
6804	228	54	0.24	773	16	16	1.00	16.43
6808	157	4	0.03	884	2	1	0.50	30.75
6809	216	61	0.28	927	7	7	1.00	433.26
6811	173	17	0.10	972	12	12	1.00	677.35
6905	64	58	0.91	1182	30	23	0.77	129.40
6908	59	48	0.81	1266	30	13	0.43	43.70
6911	57	44	0.77	1364	23	12	0.52	208.70
7002	46	40	0.87	1436	25	9	0.36	71.20
7006	46	40	0.87	1554	26	10	0.38	40.60
7010	44	36	0.82	1684	20	6	0.30	129.40
7102	55	36	0.65	1807	18	4	0.22	23.60

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1967</u>								
6704	158	30	0.19	24	19	1	0.05	0.43
6706-1	89	3	0.03	105	3	1	0.33	16.67
6711	137	27	0.20	231	1	1	1.00	0.37
6711-1	112	31	0.28	260	2	2	1.00	0.29
6801	140	17	0.12	317	12	9	0.75	59.35
6802	98	21	0.21	348	8	1	0.13	2.05
6803	148	22	0.15	377	11	10	0.91	60.50
6804	228	54	0.24	408	16	13	0.81	17.33
6809	216	61	0.28	562	7	5	0.71	281.97
6811	173	17	0.10	607	12	12	1.00	1212.41
6905	64	58	0.91	817	30	28	0.93	385.30
6908	59	48	0.81	901	30	20	0.67	128.50
6911	57	44	0.77	999	23?	25	1.00	1047.50
7002	46	40	0.87	1071	25	21	0.84	229.10
7006	46	40	0.87	1189	26	21	0.81	274.40
7009	*			1285				
7010	44	36	0.82	1319	20	15	0.75	978.10
7102	55	36	0.65	1442	18	13	0.72	121.60
7104	37	31	0.84	1509	17	13	0.76	134.60
7108	*			1635				
7109	36	31	0.86	1665	23	11	0.48	154.50
7111	19	18	0.95	1724	16	2	0.13	186.50
7204	28	25	0.89	1874	20	9	0.45	182.40
7210	*							
7211	26	24	0.92	2081	22	0		
7303	32	27	0.84	2194	24	0		
7305	22	21	0.95	2256	20	7	0.35	142.80

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1968</u>								
6804	228	54	0.24	43	16	1	0.06	0.04
6809	216	61	0.28	197	7	2	0.29	82.79
6811	173	17	0.10	242	12	7	0.58	162.94
6905	64	58	0.91	451	30	23	0.77	468.60
6908	59	48	0.81	535	30	18	0.60	66.80
6911	57	44	0.77	633	23?	24	1.00	1794.3
7002	46	40	0.87	705	25	23	0.92	310.00
7006	46	40	0.87	823	26	25	0.96	573.50
7009	o*			919				
7010	44	36	0.82	953	20	18	0.90	2087.50
7102	55	36	0.65	1076	18	18	1.00	92.90
7104	37	31	0.84	1143	17	17	1.00	255.00
7108	*			1269				
7109	36	31	0.86	1299	23	20	0.87	684.40
7111	19	18	0.95	1358	16	10	0.63	286.90
7204	28	25	0.89	1508	20	16	0.80	251.00
7210	*			1678				
7211	26	24	0.92	1715	22	1	0.05	4.10
7303	32	27	0.84	1828	24	7	0.29	27.80
7305	22	21	0.95	1890	20	9	0.45	212.50
7308	*							
7310	47	45	0.96	2053	34	4	0.12	31.50
7404	39	35	0.90	2247	29	6	0.21	37.80
7410	*							
7411	41	36	0.88	2451	29	1	0.03	0.70
7502	44	35	0.80	2542	31	2	0.06	1.40
7604	46	38	0.83	2980	33	2	0.06	4.50

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1969</u>								
6908	59	48	0.81	170	30	7	0.23	17.40
6911	57	49	0.77	268	23	15	0.65	2303.80
7002	46	40	0.87	340	25	21	0.84	813.40
7006	46	40	0.87	458	26	18	0.69	470.50
7009	*			554				
7010	44	36	0.82	588	20	17	0.85	1069.50
7102	55	36	0.65	711	18	15	0.83	278.20
7104	37	31	0.84	778	17	15	0.88	167.90
7108	*			904				
7109	36	31	0.86	934	23	23	1.00	1981.00
7111	19	18	0.95	993	16	16	1.00	1595.10
7204	28	25	0.89	1143	20	19	0.95	411.00
7210	*			1313				
7211	26	24	0.92	1350	22	8	0.36	652.70
7303	32	27	0.84	1463	24	22	0.92	355.70
7305	22	21	0.95	1525	20	17	0.85	568.90
7310	47	45	0.96	1688	34	17	0.50	247.20
7404	39	35	0.90	1882	29	17	0.59	256.80
7411	41	36	0.88	2086	29	5	0.17	38.00
7502	44	35	0.80	2177	31	4	0.13	24.50
7504	18	15	0.83	2240	10	1	0.10	8.00
7604	46	38	0.83	2615	33	6	0.18	7.10

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
YEAR CLASS 1970								
7006	46	40	0.87	93	26	13	0.50	418.30
7010	44	36	0.82	223	20	10	0.50	780.50
7102	55	36	0.65	346	18	17	0.94	255.70
7104	37	31	0.84	413	17	12	0.71	469.80
7108	*			539				
7109	36	31	0.86	569	23	20	0.87	1683.30
7111	19	18	0.95	628	16	16	1.00	2571.10
7204	28	25	0.89	778	20	19	0.95	925.90
7210	*			948				
7211	26	24	0.92	985	22	20	0.91	2494.80
7303	32	27	0.84	1098	24	26?	1.00	1282.20
7305	22	21	0.95	1160	20	18	0.90	632.80
7308	*			1269				
7310	47	45	0.96	1323	34	32	0.94	1007.00
7404	39	35	0.90	1517	29	29	1.00	1227.20
7410	*			1690				
7411	41	36	0.88	1721	29	19	0.66	253.90
7502	44	35	0.80	1812	31	20	0.65	141.40
7504	18	15	0.83	1875	10	6	0.60	204.70
7509	28	14			11	0		
7510	40	34	0.85	2043	31	6	0.19	29.60
7511	*			2072				
7604	46	38	0.83	2250	33	21	0.64	73.30
7606	54	37	0.72	2308	31	2	0.06	4.80
7611	70	46	0.66	2450	41	5	0.12	2.90
7702	54	53	0.93	2548	48	4	0.08	3.30

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1971</u>								
7108	*			174				
7204	28	25	0.89	413	20	10	0.50	337.9
7210	*			583				
7211	26	24	0.92	620	22	19	0.86	4024.00
7303	32	27	0.84	733	24	23	0.96	949.70
7305	22	21	0.95	795	20	14	0.70	353.20
7308	*			904				
7310	47	45	0.96	958	34	34	1.00	1381.70
7404	39	35	0.90	1152	29	27	0.93	1224.30
7410	*			1325				
7411	41	36	0.88	1356	29	27	0.93	1119.30
7502	44	35	0.80	1447	31	19	0.94	243.40
7504	18	15	0.83	1510	10	10	1.00	703.50
7509	28	14	0.50	1653	11	6	0.55	15.40
7510	40	34	0.85	1678	31	26	0.84	530.60
7511								
7604	46	38	0.83	1885	33	30	0.91	343.00
7606	54	39	0.72	1943	31	10	0.32	47.40
7609	72	60	0.83	2033	55	5	0.09	100.50
7610	32	25	0.78		21	0	0	
7611	70	46	0.66	2085	41	15	0.37	70.00
7701	18	13	0.72		12	0	0	
7702	54	53	0.98	2183	48	13	0.27	42.6
7704	28	21	0.75	2242	19	1	0.05	33.50
7710	35	22	0.63		17	0	0	
7711	61	44	0.72	2444	35	1	0.30	0.30

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1972</u>								
7210	*			217				
7211	26	24	0.92	254	22	12	0.55	445.60
7303	32	27	0.84	367	24	8	0.33	58.60
7305	22	21	0.95	429	20	3	0.15	38.80
7308	*			538				
7310	47	45	0.96	592	34	27	0.79	626.00
7404	39	35	0.90	786	29	19	0.66	578.10
7410	*			959				
7411	41	36	0.88	990	29	29	1.00	1012.30
7502	44	35	0.80	1081	31	26	0.84	265.90
7504	18	15	0.83	1144	10	10	1.00	770.10
7509	28	14	0.50	1287	11	9	0.82	339.80
7510	40	34	0.85	1312	31	31	1.00	1025.20
7511								
7604	46	38	0.83	1519	33	32	0.97	402.90
7606	54	39	0.72	1577	31	18	0.58	129.00
7609	72	60	0.83	1667	55	18	0.33	415.90
7610	32	25	0.78	1694	21	4	0.19	74.10
7611	70	46	0.66	1719	41	26	0.63	392.00
7701	18	13	0.72	1785	12	4	0.33	150.80
7702	54	53	0.98	1817	48	34	0.71	114.40
7704	28	21	0.75	1876	19	7	0.37	143.40
7710	35	22	0.62	2050	17	1	0.06	
7711	61	44	0.72	2078	35	6	0.17	14.40
7802	96	25	0.26	2147	7	1	0.14	0.16
7803	156	50	0.32	2167	23	9	0.39	38.94

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1973</u>								
7308	*			173				
7310	47	45	0.96	227	34	13	0.38	389.50
7404	39	35	0.90	421	29	4	0.14	32.80
7410	*			594				
7411	41	36	0.88	625	29	21	0.72	412.90
7502	44	35	0.80	716	31	22	0.71	198.10
7504	18	15	0.83	779	10	5	0.50	152.80
7509	23	14	0.50	922	11	10	0.91	630.80
7510	40	34	0.85	947	31	31	1.00	970.20
7511								
7604	46	38	0.83	1154	33	24	0.73	188.40
7606	54	37	0.72	1212	31	19	0.61	284.30
7609	72	60	0.83	1302	55	25	0.45	1281.20
7610	32	25	0.78	1329	21	8	0.38	201.60
7611	70	46	0.66	1354	41	27	0.55	359.70
7701	18	13	0.72	1420	12	6	0.05	396.70
7702	54	53	0.98	1452	48	39	0.81	166.80
7704	28	21	0.75	1511	19	12	0.63	1630.30
7710	35	22	0.63	1685	17	5	0.29	5.60
7711	61	44	0.72	1713	35	25	0.71	78.40
7802	96	25	0.26	1782	7	2	0.29	0.52
7803	156	50	0.32	1802	23	12	0.52	26.66
7910	75	55	0.73	2154	51	2	0.04	5.35
<u>YEAR CLASS 1974</u>								
7410	*			229				
7411	41	36	0.88	260	29	3	0.10	89.00
7502	44	35	0.80	351	31	3	0.10	222.40
7504	18	15	0.83	414	10	1	0.10	50.00
7509	28	14	0.50	557	11	9	0.82	205.90
7510	40	34	0.85	582	31	16	0.52	101.20
7511	*			611				
7604	46	38	0.83	789	33	5	0.15	28.90
7606	54	39	0.72	847	31	19	0.61	230.50
7609	72	60	0.83	937	55	18	0.33	359.40
7610	32	25	0.78	964	21	9	0.43	212.40
7611	70	46	0.66	989	41	20	0.49	168.90
7701	18	13	0.16	1055	12	4	0.33	212.40
7702	54	53	0.98	1087	48	26	0.54	140.40
7704	28	21	0.75	1146	19	14	0.74	868.70
7710	35	22	0.63	1320	17	9	0.53	58.00
7711	61	44	0.72	1348	35	25	0.71	125.60
7802	96	25	0.26	1416	7	6	0.86	275.28
7803	156	50	0.32	1436	23	13	0.57	28.74
7910	75	55	0.73	1789	51	8	0.16	0.65

Cruise I.D.	No. samples	No. positive	% positive	Days old	Samples aged	YC samples	% YC	No. aged
<u>YEAR CLASS 1975</u>								
7509	28	14	0.50	192	11	3	0.27	882.70
7510	40	34	0.85	217	31	2	0.06	73.50
7511	*			246				
7604	46	38	0.83	424	33	2	0.06	35.80
7606	54	39	0.72	482	31	20	0.65	651.10
7609	72	60	0.83	572	55	18	0.33	700.20
7610	32	25	0.78	599	21	10	0.48	351.00
7611	70	46	0.66	624	41	14	0.34	121.10
7701	18	13	0.72	690	12	9	0.75	1497.80
7702	54	53	0.98	722	48	10	0.21	83.10
7704	28	21	0.75	781	19	12	0.63	562.50
7710	35	22	0.63	955	17	8	0.47	161.80
7711	61	44	0.72	983	35	23	0.66	98.80
7802	96	25	0.26	1051	7	6	0.86	186.60
7803	156	50	0.32	1071	23	14	0.61	44.14
7910	75	55	0.73	1423	51	15	0.29	78.09
<u>YEAR CLASS 1976</u>								
7606	54	39	0.72	116	31	15	0.48	4024.40
7609	72	60	0.83	206	55	40	0.73	14814.00
7610	32	25	0.78	233	21	21	1.00	7878.50
7611	70	46	0.66	258	41	24	0.59	5811.80
7701	18	13	0.72	324	12	11	0.92	6088.40
7702	54	53	0.98	356	48	34	0.71	2415.0
7704	28	21	0.75	415	19	17	0.89	1196.50
7710	35	22	0.63	589	17	16	0.94	1442.10
7711	61	44	0.72	617	35	28	0.80	298.60
7802	96	25	0.26	686	7	7	1.00	462.60
7803	156	50	0.32	706	23	20	0.87	109.94
7806	80	1	0.01	808	1	1	1.00	8.00
7910	75	55	0.73	1058	51	24	0.47	166.65
<u>YEAR CLASS 1977</u>								
7710	35	22	0.63	224	17	6	0.35	41.80
7711	61	44	0.72	252	35	25	0.71	327.80
7802	96	25	0.26	321	7	1	0.14	0.80
7803	156	50	0.32	341	23	13	0.57	21.44
7806	80	1	0.01	443	1	1	1.00	18.00
7910	75	55	0.73	693	51	31	0.61	132.31
<u>YEAR CLASS 1978</u>								
7910	75	55	0.73	328	51	43	0.84	1394.16


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400 PAGE "
410 PRINT " CRUISE ";A$;" TOTAL STATIONS ";B$
420 IMAGE 3D,1D,X,6(6D,X),S
430 IMAGE 2(6D,X),7D
440 PRINT STA 1 2 3 4 5 6 "
450 C$=" NO.CAP."
460 C$=" 7
470 C$="CT E$
480 PRINT
490 PRINT FOR P=1 TO R
500 PRINT USING 420:Y(P,1),Y(P,2),Y(P,3),Y(P,4),Y(P,5),Y(P,6),Y(P,7)
510 PRINT USING 430:Y(P,8),Y(P,9),Y(P,10)
520 NEXT P
530 DIM Y1(10)
540 Y1(1)=0
550 FOR S=2 TO 10
560 Y1(S)=0
570 FOR P=1 TO R
580 Y1(S)=Y(P,S)+Y1(S)
590 NEXT P
600 NEXT S
610 NEXT S
620 R$="-----"
630 S$=R$
640 T$=R$
650 PRINT 6A,6(6D,X),S
660 IMAGE 2(6D,X),7D
670 IMAGE USING 660:"TOTAL",Y1(2),Y1(3),Y1(4),Y1(5),Y1(6),Y1(7)
680 PRINT USING 670:Y1(8),Y1(9),Y1(10)
690 PRINT
700 PRINT
710 PRINT "NUMBER OF STATIONS WITH AGED ANCHOVY ";R
720 PRINT "NUMBER OF STATIONS WITH ANCHOVY ";N$
730 PRINT X$
740

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1000 GO TO 2230
1010 REM X(A,B)
1020 DIM X(12,10)
1030 FOR A=1 TO 12
1040 FOR B=1 TO 10
1050 X(A,B)=0
1060 NEXT B
1070 NEXT A
1080 PRINT "WHAT YEAR?"
1090 INPUT Z$
1100 "ENTER CRUISE (AS A DECIMAL) AND TOTAL CAPTURED"
1110 X(K,1),X(K,10)
1120 "ENTER YEAR CLASS"
1130 INPUT B
1140 "ENTER NUMBER IN YEAR CLASS"
1150 INPUT X(K,B)
1160 "ANOTHER YEAR CLASS?"
1170 INPUT Q$
1180 IF Q$="Y" THEN 890
1190 PRINT "ANOTHER CRUISE?"
1200 INPUT H$
1210 IF H$="Y" THEN 860
1220 PAGE
1230 PRINT " YEAR "Z$
1240 PRINT
1250 C$="CRUISE 1 2 3 4 5 6 "
1260 D$="?"
1270 E$="C$&D$
1280 PRINT E$
1290 PRINT
1300 IMAGE 3D,2D,6D,5(7D),S
1310 IMAGE 6H,6D,5(7D),S
1320 IMAGE 2(7D),8D

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1100 FOR A=1 TO K
1110 PRINT USING 1070:X(A,1),X(A,2),X(A,3),X(A,4),X(A,5),X(A,6),X(A,7)
1120 PRINT USING 1090:X(A,8),X(A,9),X(A,10)
1130 NEXT A
1140 DIM X1(10)
1150 X1(1)=0
1160 X1(2)=0
1170 FOR B=2 TO 10
1180 X1(B)=0
1190 FOR A=1 TO K
1200 X1(B)=X(A,B)+X1(B)
1210 NEXT A
1220 NEXT B
1230 R$="-----"
1240 S$=R$
1250 T$=R$
1260 PRINT T$
1270 PRINT USING 1080:"TOTAL ",X1(2),X1(3),X1(4),X1(5),X1(6),X1(7)
1280 PRINT USING 1090:X1(8),X1(9),X1(10)
1290 GO TO 2230
1300 REM Y.C. 23 IS 1947
1310 REM YEAR BEGINS IN JULY (1954 STARTS JULY 1954)
1320 REM Z(I,9)
1330 DIM Z(18,23)
1340 FOR T=1 TO 18
1350 FOR S=1 TO 23
1360 Z(T,S)=0
1370 NEXT S
1380 NEXT T
1390 L=0
1400 PRINT "WHAT IS YEAR AND TOTAL CAPTURE?"
1410 L=L+1
1420 INPUT Z(L,1),C
1430 PRINT "WHAT IS YEAR CLASS AND COUNT?"
1440 INPUT S,B

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1450 Z(L,S)=B/C*100
1460 PRINT "ANOTHER YEAR CLASS?"
1470 INPUT H$
1480 IF H$="Y" THEN 1430
1490 PRINT "ANOTHER YEAR?"
1500 INPUT Q$
1510 IF Q$="Y" THEN 1400
1520 GOTO 1450
1530 PRINT "
1540 PRINT "INCIDENCE OF YEAR CLASSES"
1550 PRINT "YEAR: 60 67 66 65 64 63 62 61 60 ";
1560 PRINT "59 58 57 56 55 54 53 52 51 50 49 48 47"
1570 PRINT
1580 IMAGE 4D,2X,6(2D,X),S
1590 IMAGE 6(2D,X),S
1600 IMAGE 6(2D,X),S
1610 IMAGE 4(2D,X)
1620 FOR T=1 TO L
1630 PRINT USING 1580:Z(T,1),Z(T,2),Z(T,3),Z(T,4),Z(T,5),Z(T,6),Z(T,7)
1640 PRINT USING 1590:Z(T,8),Z(T,9),Z(T,10),Z(T,11),Z(T,12),Z(T,13)
1650 PRINT USING 1600:Z(T,14),Z(T,15),Z(T,16),Z(T,17),Z(T,18),Z(T,19)
1660 PRINT USING 1610:Z(T,20),Z(T,21),Z(T,22),Z(T,23)
1670 NEXT T
1680 GO TO 2230
1690 PRINT "YEAR CLASS"
1700 DELETE R
1710 INPUT L
1720 DIM V(30,9)
1730 FOR Y=1 TO 30
1740 FOR Z=1 TO 9
1750 V(Y,Z)=0
1760 NEXT Z
1770 NEXT Y
1780 R=0
1790 PRINT "CRUISE, NO. STATIONS,&NO. YEAR CLASS ";L;" ANCHOVIES"

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1900 R=R+1
1910 INPUT U(R,1),U(R,2),U
1920 PRINT "NO. STATIONS WITH ANCHOVY?"
1930 INPUT U(R,3)
1940 PRINT "NO. STATIONS WITH YEAR CLASS ";L
1950 INPUT U(R,7)
1960 PRINT "NUMBER OF STATIONS WITH AGED ANCHOVIES?"
1970 INPUT U(R,6)
1980 U(R,9)=U/U(R,3)
1990 U(R,4)=U(R,3)/U(R,2)
2000 U(R,8)=U(R,7)/U(R,6)
2010 REM ANCHOVIES BORN MARCH 17
2020 PRINT "MIDPOINT OF CRUISE (EG 1,13,1979)"
2030 INPUT M,D,Y
2040 IF M=1 THEN 1980
2050 IF M=2 THEN 1980
2060 N1=365.25*Y+30.6*(M+1)+D-621049
2070 GO TO 1990
2080 N1=365.25*(Y-1)+30.6*(M+13)+D-621049
2090 N2=365.25*L+30.6*(3+1)+17-621049
2100 U(R,5)=N1-N2
2110 PRINT "ANOTHER CRUISE?"
2120 INPUT H$
2130 IF H$="Y" THEN 1790
2140 IMAGE X,2D,2D,2X,3D,2X,2D,2X,1D,2D,2X,6D,2X,3
2150 IMAGE 2D,2X,2D,2X,1D,2D,2X,5D,2D
2160 PAGE
2170 PRINT
2180 "
2190 "CRUISE STA SA SA/STA DO SAA SYC YC/AA YCA/SA"
2200 PRINT
2210 FOR W=1 TO R
2220 PRINT USING 2040:U(W,1),U(W,2),U(W,3),U(W,4),U(W,5)
2230 PRINT USING 2050:U(W,6),U(W,7),U(W,8),U(W,9)
2240 NEXT W

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0150 COPY
0160 PAGE
0170 PRINT "WHAT FILE?"
0180 INPUT F
0190 FIND F
0200 DIM V(R,9)
0210 WRITE V(R,9)
0220 WRITE @33:L,R
0230 WRITE @33:U
0240 END

SEA SURVEY ANCHOVY CATCHES
Percent Age Composition
(CALIF. DEPT. FISH AND GAME)

Appendix Table

Survey Year	0	I	II	III	IV	V	VI	VII	VIII	IX
1952	20	48	21	8	2	1				
1953	44	35	17	2	1	0	T*			
33 1954	33	26	2	1						
1955	34	31	31	3	T					
1956	51	12	33	4						
1957	30	19	1							
1958	13	74	4	4						
1959	11	64	22	2	1					
1960	8	36	48	7						
1961	27	42	19	9						
1962	23	33	27	6	T					
1963	10	23	31	27	9					
1964	5	36	29	24	2	4	T			
1965	17	24	33	23	4	T	T			
T 1966	1	36	33	23	3	T				
T 1967	16	14	16	39	14	T	1	T		
1968	7	33	33	1	13	13	T			
4 1969	36	32	21	5	1	2	T			
1970	22	22	35	18	2	1				
1971	3	46	35	11	5					
1972	4	44	36	13	2	1				
1973	6	17	37	32	7	1				
1974	6	13	35	35	10	1	T			
35 1975	15	5	18	17	8	1	T	T		
1976	31	7	4	9	3	1	T			
1977	14	66	10	7	3	1	T			
* 78	55	16%	20%							

*T = < 0.5%

COMMERCIAL AND BAIT CATCH ANALYSIS

Anchovy Age Composition by Number

(CALIF. DEPT. FISH AND GAME)

Appendix Table

YEAR	0	I	II	III	IV	V	VI	VII		
1952-3	12	11	31	26	15	4	T ^x			
53	17	37	35	19	3	T	T			
54	13	52	27	6	1	T				
55	6	50	34	8	T	T				
56	2	24	58	11	1	T				
57	2	43	27	10	2	T				
58	11	62	25	2	T					
59	69	21	9	T						
60	16	40	36	4						
61	11	46	34	9	T					
62	9	41	35	7	4					
63	16	46	30	6	2	T				
64	22	45	25	7	1	T				
65	4	15	19	23	8	1	T			
66	7	23	38	22	8	1	T			
67	1	13	26	21	19	9	1			
68	19	46	22	3	4	1	T			
69	27	28	35	8	2	T	T			
70	4	32	40	20	3	T	T			
71	11	51	27	9	2	T				
72	9	26	43	14	2	T	T	T		
73	7	20	35	31	6	1	T			
74	5	19	40	26	12	1	T			
75	2	11	33	34	12	3	T			
76	28	12	16	23	13	3	T	T		
77	11	33	20	14						
F.W. 78		10	10							
S 78-79										
78	26	26	26	26	16	16	16			
79	13	33	33	15	4	1.2	.19			
80	14	15	11	7.7	5.7	2.3	2.1			

